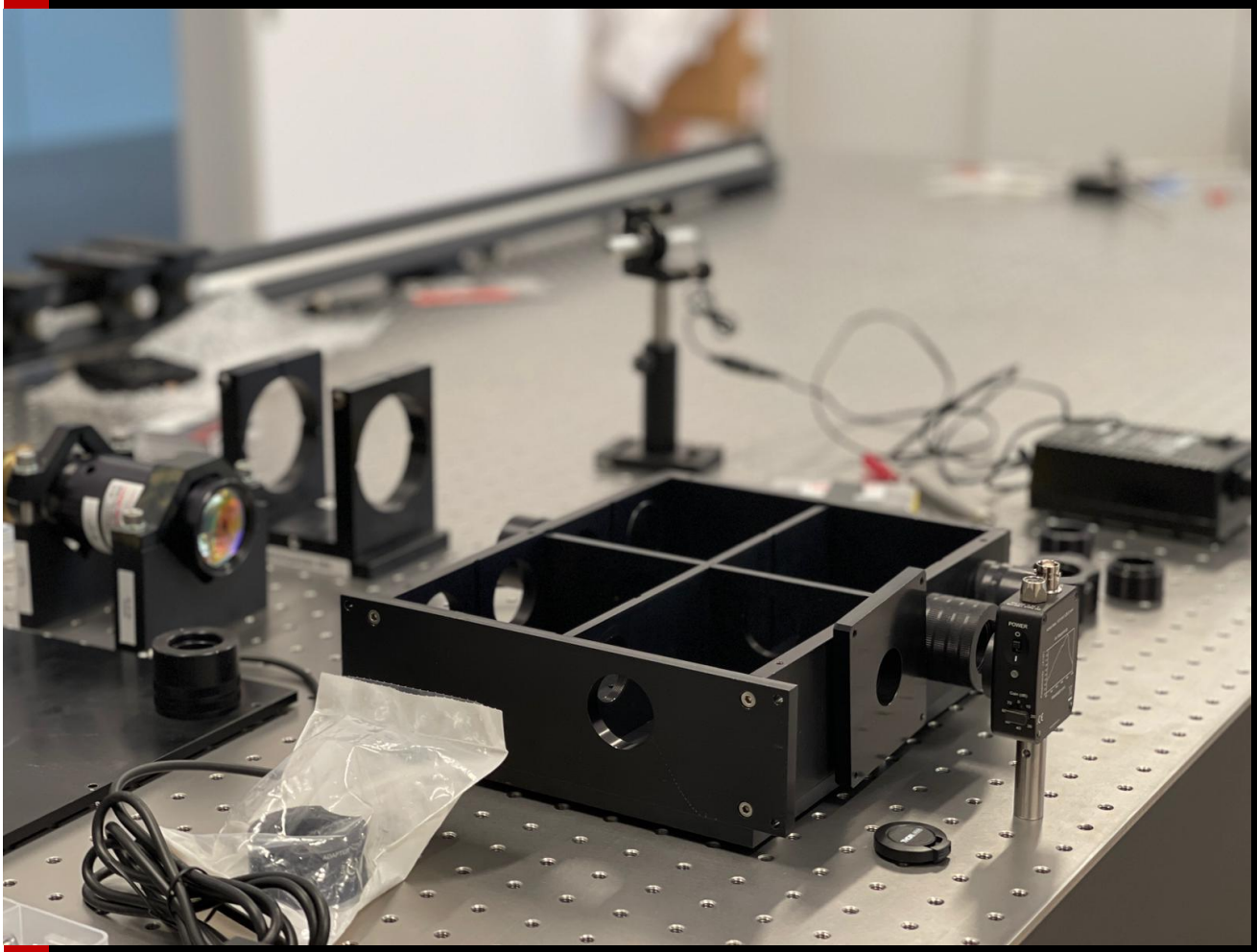


CATALOGUE OF SERVICES

National Institute of R&D for Optoelectronics

2024

HTTPS://WWW.INOE.RO/EN/ inoe@inoe.ro

The National Institute of Research and Development for Optoelectronics (INOE) offers a wide range of services to support research and development in the field of optoelectronics. From testing and characterization to consulting and training, INOE provides valuable resources to scientists, engineers, and industry professionals. This catalogue of services showcases the expertise and capabilities of INOE in advancing the field of optoelectronics.

MATERIALS

The activities address the thin films deposition of new materials, and the modification of their surface properties through plasma or vacuum processing. Research focuses on developing specific methods for obtaining and characterizing materials with applications in optoelectronics, micro- and nano-electronics, optics, medicine, and space technologies, with a focus on their complex characterisation Services are implemented in five laboratories with distinct specializations, including physical vapour deposition technologies and techniques for structural, elemental, morphological and functional characterisation of thin films.

OPTOSPINTRONICS

Studies focus on spintronic materials and light interaction mechanisms, including semi-Heusler compounds and new magnetic semiconductors, laser technology and optical modulators. Advanced technologies aim to develop complex diagnostic and monitoring methods using nano-structural properties. The department also develops synthesis technologies for special materials with magnetic properties, magneto-optic properties, and nanocomposites for magnetic field sensors.

CULTURAL HERITAGE

The activity has been oriented for over 20 years on developing advanced methods and optoelectronic systems, focusing on precision and accuracy in restoration and conservation strategies. The most advanced applications include 3D reconstruction of cultural objects, developing photonic probe methods for material characterization, and monitoring conservation sites through data collection. The laboratory for the restoration and conservation of cultural goods (CERTO) carries out physical and chemical investigations according to the Operating Authorization no. 64/27.05.2014, issued by the Ministry of Culture for the protection of the national cultural heritage. It is a centre of competence recognized by ICOMOS, partner of the National Museum of Art of Romania, the Museum of the Municipality of Bucharest, the Association of Experts and Art Evaluators from Romania, initiator member of CT 380 ASRO.

ENVIRONMENT AND CLIMATE

Research addresses environmental, climate and health programmes. Main services refer to the evaluation of the quality of the environment and development of environmental remediation technologies. Opto-spectral methods for water quality assessment are used to investigate dissolved and particulate organic matter and emerging pollutants from aquatic systems. In-situ and remote sensing techniques are employed to study the atmosphere and the essential climate variables, for quantifying physical-chemical processes in the planetary boundary layer and free troposphere, and to enable the validation of satellite data products. The Environmental Analysis Laboratory (LAM) is accredited according to SR EN ISO/CEI 17025 by the Accreditation Association of Romania, RENAR and authorized ANSVSA to carry out tests from samples of water, soil, sediment, air, mud, vegetation, food.

BIORESOURCES

The research concerns the development of advanced analytical methods for the identification and recovery of valuable elements from electronic waste/mining stores, aimed at the implementation of principles of the circular economy; development of new types of systems, equipment, optoelectronic instrumentation for analytical investigation with applications in environmental protection, health, food safety, technological upgrades, clean technologies; bioenergy, biomass (development of innovative technologies, cost-effective for the exploitation of renewable resources with the obtaining of biofuels and their implementation on a large scale in the market, determination of the quality of bio-fuels, and conducting trials for the certification of Biofuels in accordance with European standards), development of modern materials/nanomaterials with application in medicine or construction.

OPTOELECTRONIC EQUIPMENT

The main focus is on the development of solid-state lasers, laser and fiber-based devices for various industries, medicine, civil engineering, and security. The certified laboratory (INDICO) is a European certification body that focuses on evaluating materials, components, and systems for optoelectronic applications using optical and complementary methods. Its main goal is to determine specific optical parameters for optoelectronic applications, such as identifying and characterizing materials used in optoelectronics, determining the level of laser energy, laser pulse length, laser beam diameter, laser intensity distribution, and wavelength distribution. INDICO's certification allows high precision determinations for laser and optical fiber systems.

MECHATRONICS

The main activity includes hydroelectric and mechatronic technology for automating and robotic systems, environmental, ecology, and renewable energy, hydroelectric, mechatronic, and tribological aspects, and the development of complex automation systems based on hydraulic and pneumatic equipment. The focus is also on renewable energy sources, specifically the use of hydrostatic and pneumatic systems in specific renewable energy conversion equipment.

CONSULTANCY AND TRAINING

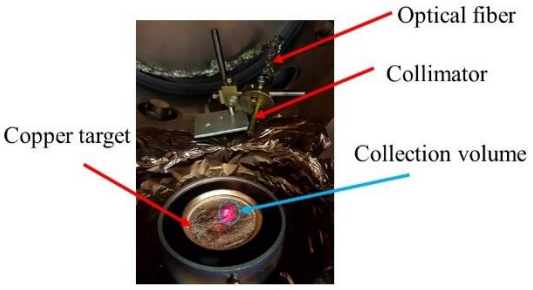
The Institute also offers consultation and technical assistance from specialists, vocational training and specialization, and organization of scientific events.

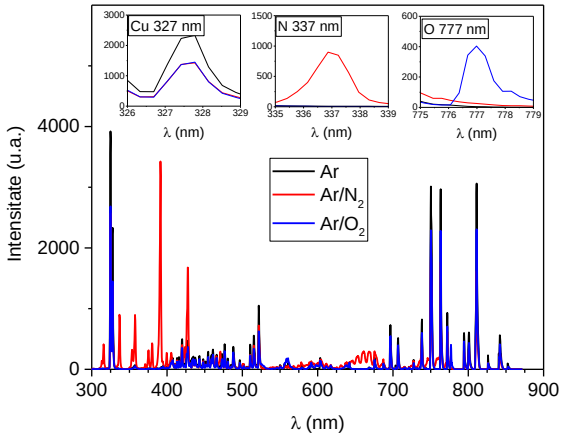
INDEX

MATERIALS

CONFIGURATION, TESTING AND IMPLEMENTATION OF TECHNOLOGICAL PLASMA DIAGNOSTICS SYSTEMS

Type of the service	Technological service
Targeted areas	• Technological plasmas diagnostics • Technology development for thin films deposition • Fundamental and applied research



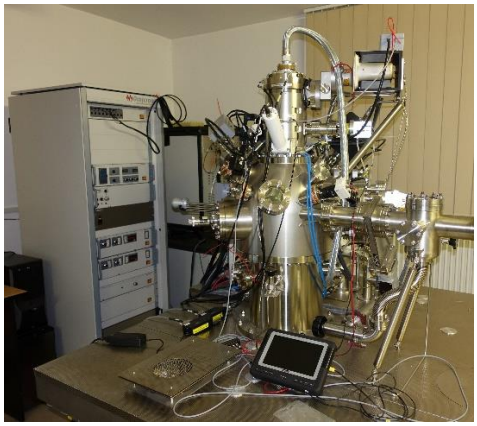


Short description	In the ReCAST department of INOE, physical vapour deposition technologies are implemented to obtain thin films. The development of such technologies includes the process plasma diagnostics, intended to provide a better understanding and control of process parameters. The service refers to the diagnostics and control of process plasmas, including consulting services regarding the diagnostics of process plasmas, configuration, testing and implementation services of plasma diagnostics systems, leading to the optimization of plasma processes (to stabilize processes and obtain layers/surfaces with controllable and adjustable properties). The service is addressed both to research entities in the field of thin film deposition and to economic operators who want to implement, optimize or characterize deposition processes involving plasma technologies.
Type of access	Physical
Access to service	The configuration of the diagnostic systems of the process plasmas can be carried out both at the INOE headquarters, using the deposition facilities and already existing diagnostic systems, as well as systems or parts of the beneficiary's diagnostic systems that can be tested and configured. Likewise, the implementation of diagnostic procedures and the optimization of plasma processes can be carried out at the beneficiary's premises, using the facilities provided by him. If the beneficiary wishes to purchase commercial diagnostic systems, the service provided includes both assistance

	in choosing and purchasing the right systems, as well as commissioning and configuring them at the beneficiary's location.
Technical details	**Laboratories and equipment involved** The infrastructure used in this type of service is part of the *Laboratory for thin film deposition by PVD methods - PVD Lab*, which includes the experimental facility dedicated to testing and implementing diagnostic systems (https://eertis.eu/ereq-2300-007c-4175) as well as plasma diagnostic systems (https://eertis.eu/ereq-2300-007h-4187) **Applicable standard methods and procedures** For the calibration of diagnostic systems by optical emission spectroscopy, the standard procedures of spectrometer manufacturers are applied, using calibrated spectral lamps. The NIST (National Institute of Standards and Technology) database is used to identify the spectral lines of interest specific to the investigated plasmas https://physics.nist.gov/PhysRefData/ASD/lines_form.html **Representative parameters and accuracy** The spectral domain in which the emission spectra can be recorded is between 200 and 900 nm, with a spectral resolution of 0.3 nm and a typical temporal resolution of the order of 1s.
Deliverables	Studies and technical-scientific analyses regarding the correlation of process parameters with the properties of the obtained thin layers. Experiment report on the configuration of plasma diagnostic systems Procedures for the characterization of process plasmas adapted to the intended applications
References	The implementation of plasma diagnostics systems was demonstrated by published articles: J. Oliveira, F. Ferreira, R. Serra, T. Kubart, C. Vitelaru, A. Cavaleiro, *Coatings* **10** (2020) 1-16; C. Vitelaru, I. Pana, A.E. Kiss, N.C. Zoita, A. Vladescu, M. Braic, *Journal of Optoelectronics and Advanced Materials*, **21** (2019) 717-725, I. Pana, C. Vitelaru, N.C. Zoita, M. Braic, *Plasma Processes and Polymers*, **13** (2016) 208-216,
Terms of execution	(Fixed text) Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://recast.inoe.ro/Home.html Email: catalin.vitelaru@inoe.ro

ELEMENTAL CHEMICAL CHARACTERISATION OF MATERIALS

Type of the service	Scientific service
Targeted areas	• Material science • Nanotechnology • Microelectronics



Short description	In INOE, the ReCAST group operates a TM 3030 Plus electron microscope (Hitachi) equipped with an energy dispersive X-ray spectrometer (EDX) and a Nano SAM S electron microscope (Omicron) equipped with an Auger electron spectrometer. The energy dispersive X-ray spectrometer is used for qualitative and quantitative elemental chemical analysis of electrically conductive or insulating samples, with micrometric lateral and vertical resolution. The technique is non-destructive for the sample, has high sensitivity for chemical elements with Z>3, is fast and allows the analysis of large samples. This technique is addressed to research and industrial laboratories and universities. The Auger electron spectrometer is used for qualitative and quantitative elemental chemical analysis of the surface of electrically conductive samples with lateral and vertical resolution of 5 nm. The Auger technique is only suitable for samples compatible with ultra high vacuum ($2x10^{-10}$mbar). The Auger spectrometer is used to detect impurities and contaminants on the investigated surfaces, being used for the study of thin conducting and semiconducting layers. This technique is addressed to research laboratories for materials used in the semiconductor and microelectronics industry.
Type of access	Physical
Access to service	The beneficiary of this service provides the samples to be measured according to the specifications and participates in the analysis of the samples to guide the operator towards the details of interest during the analysis. The service is performed at the INOE locations where the analysis equipment is located.

Technical details	**Laboratories and equipment involved** The two spectrometers are part of the LanE laboratory - Elemental and Morphological Analysis Laboratory - of INOE. The electronic microscope TM 3030 Plus (https://eertis.eu/ereq-2300-007b-4127) is table top type and is fully controlled by software. The program for acquiring and processing the data collected by the EDX spectrometer is called Quantax 70. The Nano SAM microscope (https://eertis.eu/ereq-2300-007g-4139) is also fully controlled by software. For the acquisition of Auger electron spectrometer data is used Matrix software, and for data processing is used Casa XPS software. **Applicable standard methods and procedures** The samples analyzed by the two spectrometric methods are cleaned and processed before being fixed on the instrument support. In the user manuals of the two spectrometers, the sample preparation methods and data acquisition and processing procedures are described. **Representative parameters and accuracy** The EDX spectrometer detects chemical elements with Z > 3. The lateral resolution is 10 µm and the vertical resolution is 2 µm. The detection limit of the concentration of a chemical element is 0.1%. The Auger spectrometer detects chemical elements with Z > 3. The lateral and vertical resolution is 5 nm. The detection limit of the concentration of a chemical element is 0.1%.
Deliverables	Composition characterization report accompanied by files with the acquired data (raw and processed)
References	The equipment and investigation methods were successfully used in the research activities, the results being published in scientific articles : Orange Snow - A Saharan dust intrusion over Romania during winter conditions, L. Marmureanu, C.A. Marin, S. Andrei, B. Antonescu, D. Ene, M. Boldeanu, J. Vasilescu, C. Vitelaru, O. Cadar, E. Levei, Remote Sensing, 11 (2019) 1-22, doi: 10.3390/rs11212466 Block Copolymer Elastomer with Graphite Filler: Effect of Processing Conditions and Silane Coupling Agent on the Composite Properties, D.M. Panaitescu, R.A. Gabor, C.A. Nicolae, A.C. Parau, C. Vitelaru, V. Raditoiu, M. Chipara, Polymers, 10 (2018) 1-16, doi: 10.3390/polym10010046 Structural, mechanical, wear and anticorrosive properties of CrSiCN coatings used for industrial woodworking applications, I. Pana, A.C. Parau, M. Dinu, C. Vitelaru, D.M. Vranceanu, T. Lindner, A. Vladescu (Dragomir), Heliyon, 10 (2024) 1-15, doi: 10.1016/j.heliyon.2024.e29496
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.recast.inoe.ro Email: catalin.vitelaru@inoe.ro

CHARACTERIZATION OF THE ELECTROCHEMICAL PROPERTIES OF SOLID MATERIALS/THIN FILMS

Type of the service	Scientific service
Targeted areas	• Corrosion and material protection • Biosensors and medical devices • Catalysis, nanotechnology, and nanomaterials

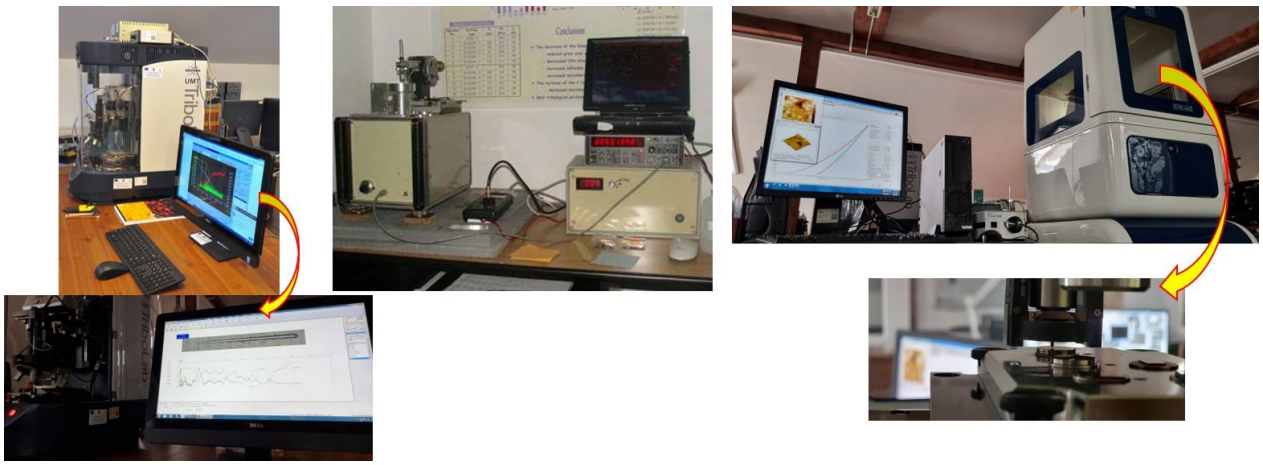
Short description	The electrochemical properties characterization service represents a specialized analysis method used to study the chemical reactions that take place at the interface between a material and the electrolyte used, and to evaluate the electrochemical behaviour in various conditions. The novelty element of this service consists in its ability to provide a detailed characterization of the electrochemical properties. Thus, by means of advanced analysis techniques, the properties necessary to understand corrosion phenomena, such as electrochemical kinetics or electrochemical reactivity, can be evaluated. As a result of applying the mentioned service, specific information can be obtained regarding the behaviour, performance, and functionality of materials in various fields (chemical industry, medical industry, environmental industry, electronic industry, etc.), thus contributing to the development of new technologies and innovative applications.
Type of access	Physical
Access to service	The characterization of the electrochemical properties of solid materials/thin films can only be performed at the INOE headquarters, with physical access (INOE experts accompany and operate the equipment). Interested beneficiaries can access this service through direct collaboration or by contracting electrochemical characterization services. Cooperation with economic agents as well as with Research Institutes or Universities is targeted. Collaboration with economic agents can be established through service contracts, aimed at analyses and characterizations necessary for quality control, development, and innovation to enhance the performance of certain products, comparisons with similar products on the market, etc. Moreover, both economic agents and other research-development entities can benefit from access to

	the existing infrastructure and expertise by participating in consortia within joint research projects.
Technical details	**Laboratories and equipment involved** The equipment for electrochemical characterization is part of the **Laboratory for functional characterizations-LaC**, which is located within *Systems and Technologies based on Plasma and Vacuum for New Advanced Nanostructured Materials (ReCAST)* department of INOE (https://eertis.eu/ereq-2300 -007d-4166). The measurements are conducted using a **VersaSTAT 3 Potentiostat/Galvanostat** (Princeton Applied Research, Oak Ridge, TN, USA), employing an electrochemical cell with a typical 3-electrode configuration (consisting of a recording electrode, reference electrode, and working electrode). Measurements can be performed in different liquid media (NaCl, SBF, PBS, Hanks, Dulbecco's, artificial saliva, etc.) and at different temperatures (from room temperature to 37°C). Data are recorded using VersaStudio software (version 2.60.6, Princeton Applied Research, Oak Ridge, TN, USA), and impedance data fitting can be performed using ZView software (version 12136-4, Scribner Associates Inc., Southern Pines, NC, USA). **Applicable standard methods and procedures** The electrochemical characterization system enables the monitoring of the open circuit potential (EOC) over time; electrochemical impedance spectroscopy (EIS) data recording in specified frequency range by applying a sinusoidal signal with a set amplitude; application of polarization techniques: linear polarization resistance (LPR) realized in the range of ±10 mV vs. EOC, generation of Tafel curves in the range ±250 mV vs. EOC, plotting the potentiodynamic curves in the range -1 V vs. EOC at +1V vs. Ref, cyclic voltammetry. Based on the measurements conducted in accordance with **ASTM G 59-97 (2014)** standard, the following corrosion parameters can be calculated: open circuit potential (EOC), corrosion potential (Ecorr), corrosion current density (icorr), polarization resistance (Rp), porosity of the working electrode (P), protection efficiency (Pe), etc. **Representative parameters and accuracy** The VersaSTAT 3 equipment can be operated in both potentiostat mode, where the applied potential is controlled (scan range ±10 V, resolution 300 nV, 3 µV, 30 µV, 300 µV, maximum scan range ±10 V / 300 µV) or in galvanostat mode, where the applied current is controlled (scan range ±650 mA (standard), ±2 A (optional), resolution 60 pA, accuracy ±0.2 %, minimum current range ±200 nA). Specifications of the impedance module: frequency range 10 µHz – 1 MHz, maximum AC amplitude 1000 mV RMS, minimum AC amplitude 0.1 mV RMS.
Deliverables	Experimental report on electrochemical characterization
References	The results of research on characterization the electrochemical properties of solid materials/thin films by potentiodynamic techniques and electrochemical impedance spectroscopy have been published in numerous specialized scientific journals, the most recent scientific journals being Materials Chemistry and Physics, Biomedicines, Ceramics International, Applied Surface Science, Corrosion Science. Additionally, innovative technologies in the field of electrochemistry were highlighted through granted invention patents (RO135722 (B1)/2024, RO133781 (B1)/2023, RO131879 (B1)/2021, RO132594 (B1)/2021, RO130253 (B1)/2020, RO130069 (B1)/2018).
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details.

	The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.recast.inoe.ro Email: mihaela.dinu@inoe.ro, catalin.vitelaru@inoe.ro

CHARACTERIZATION OF THE MECHANICAL PROPERTIES OF SOLID MATERIALS/THIN LAYERS

Type of the service	Scientific service
Targeted areas	• The machinery manufacturing industry, the processing industry, the food industry • Material Science • Medicine



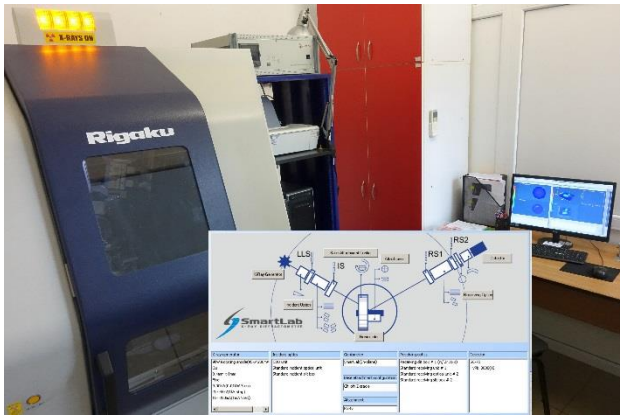
Short description	The ReCAST department within INOE has extensive experience in investigating the mechanical characteristics of various solid materials and thin layers to validate their functional properties, as well as those of the resulting products. The assessment includes a varied range of methods, allowing the evaluation of parameters such as hardness, layer adhesion to the substrate, and tribological characteristics in air/corrosive solutions. The employed techniques have a complementary nature, providing information from the nano-scale to micro-scale, up to the macroscopic functional scale. The proposed service ensures access to a diverse material base that includes a wide range of characterization techniques. Additionally, measurement techniques can be adapted and supplemented to suit the practical needs of the beneficiaries.
Type of access	Physical
Access to service	The characterization of the mechanical properties of solid materials and thin layers can only be performed at the headquarters of INOE, within the ReCAST department, with physical access only. Depending on the specifics of the investigations, the samples may require various preparation procedures before being mechanically characterized (cutting, grinding, cleaning, etc.). Before and after the completion of the tests/mechanical characterization, discussion with the beneficiary can take place to

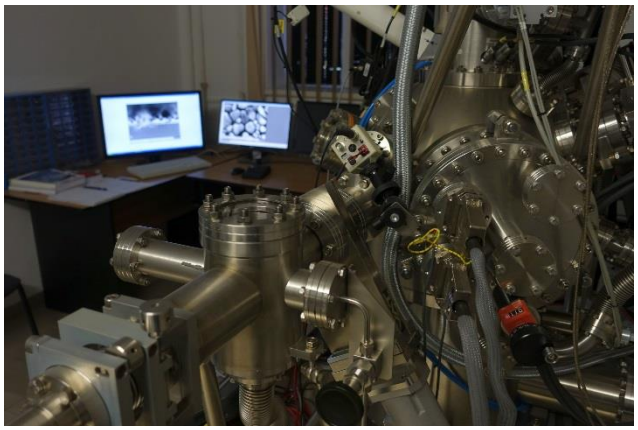
	establish the parameters of interest, suitable methods and to interpret the obtained results. Additionally, we offer flexibility in conducting complementary measurements.
Technical details	**Laboratories and equipment involved** The Functional Characterization Laboratory (LaC) within the ReCAST department at INOE is equipped with advanced mechanical characterization instruments, including: Pin-on-Disc tribometer https://recast.inoe.ro/research_facilities_si11.html, modular system for mechanical characterization (TriboLab UMT Bruker), https://eertis.eu/ereq-2300-007u-4133, Hysitron TI Premier nanoindeter https://eertis.eu/ereq-2300-007n-4130, at the nano, micro and mesoscopic scale for materials and thin layers. **Applicable standard methods and procedures** The mechanical characterization includes: • Determination of friction coefficient and wear rate (in dry or corrosive environments) according to DIN 50324 and ASTM G99 standards, depending on the sample type. Test are conducted using the tribometer and other adjacent equipment (electromechanical profilometer Dektak 150 Bruker). • Measurement of hardness and adhesion on a micro and mesoscopic scale using Rockwell and Vickers tip indentations with the TriboLab equipment. • Measurement of hardness on a nano scale using Berkovich and conical tip indentations with the Hysitron TI Premier nanoindenter. All measurements are performed following calibration standards and procedures specified by the manufactures of the characterization equipment. **Representative parameters and accuracy** • Friction coefficient and wear measurements are conducted with the Pin-on-Disk tribometer on disc shaped samples with diameters ranging from 1.6 cm to 3 cm. Tests are performed both in dry and corrosive environments. A force of 0.5 - 30 N can be applied using a 6 mm diameter saphire ball. • Hardness and adhesion on micro and mesoscopic scales are performed with the Tribolab equipment, employing load indentations (5-500mN and 1-100N) and visualizing the indentations and visualizing the indentation and scratching marks through SPM microscopy with automated sample positioning. • The Berkovich or conical tip of the nanoindenter can apply a force of 70nN-10mN for characterizing the nanohardness of the investigated sample, with can have dimensions ranging from 0.5-5 cm in width and 0.1-5 cm in height.
Deliverables	Experimental report (plus raw data upon request) regarding the testing of the mechanical characteristics of the investigated material.
References	Mechanical characterizations (tribological testing, hardness determination) had been conducted for the National Institute for Research and Development in Mechatronics and Measurement Technique (INCDMTM), as well as for the National Institute for Lasers, Plasma and Radiation Physics (INFLPR). From the publications and patents that include mechanical characterizations by the ReCAST department team, we mention:

	Structural, mechanical, wear and anticorrosive properties of CrSiCN coatings used for industrial woodworking applications, I. Pana et all, Heliyon 10 (2024) 1-15, doi: 10.1016/j.heliyon.2024.e29496 Structural, electrochemical, biological, and mechanical assessment of functionally graded Cr-based multilayers for enhanced metal-ceramic bond strength in dental restorations, M. Dinu et all, Materials Chemistry and Physics 312 (2024) 1-13, doi: 10.1016/j.matchemphys.2023.128655 RO135722 (B1)/2024 –Method for preparing high entropy alloys (HEA) as powder for plasma jet coatings and alloys obtained thereby, N.C. Zoita et all. RO133549 (B1)/2023 – Enhancing orthopaedic implant bioactivity by coating the same with doped hydroxyapatite, A. Vladescu et all.
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://recast.inoe.ro Email: anca.parau@inoe.ro, catalin.vitelaru@inoe.ro

STRUCTURAL CHARACTERISATION OF THIN FILMS

Type of the service	Scientific service
Targeted areas	• Materials science • Nanotechnology • Microelectronics





Short description	INOE offers advanced services for the high-sensitivity structural analysis of bulk materials, thin films, and thin-film structures. The service is performed by the Laboratory for Structural Analysis (LAnS), which uses characterisation methods based on techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM) on the surface or in cross-section, and Fourier-transform infrared spectroscopy (FTIR). These methods enable accurate and detailed structural characterizations at maro-, micro- or nanoscopic scales, depending on the technique used, which are essential for innovations in the field of advanced materials.
Type of access	Physical
Access to service	The service is carried out at INOE. Access is physical. The beneficiary must provide samples with dimensions and weight compatible with the instrumentation involved and specify the type of service (measurements, measurements + data analysis, measurements + data analysis + interpretation of results). On request, the beneficiary can assist the user.

Technical details	**Laboratories and equipment involved** Laboratory for structural analysis-LanS (https://eertis.eu/erlb-2300-000n-8452) Laboratory for Elemental and Morphological Analysis-LanE (https://eertis.eu/erlb-2300-000r-8229) Laboratory for Functional Characterization (https://eertis.eu/erlb-2300-000k-8468) Equipments: • Rigaku SmartLab X-Ray Diffractometer equipped with Anton Paar DHS 1100 domed hot stage heating attachment (https://eertis.eu/ereq-2300-007a-4136); • Rigaku Miniflex II X-Ray Diffractometer (https://eertis.eu/ereq-2300-007s-4151); • OMICRON NanoSAM Lab S HR-SEM/SAM (https://eertis.eu/ereq-2300-007g-4139); • Jasco FT-IR-6300 Fourier Transform Infrared Spectrometer equipped with Pike MIRacle – universal ATR (https://eertis.eu/ereq-2300-007e-4157); **Applicable standard methods and procedures** XRD methods (Rigaku SmartLab): • High-resolution X-ray diffraction in Bragg-Brentano or parallel beam configuration using symmetric or asymmetric scanning, including the grazing incidence method (HR-XRD $2\theta/\theta$, $2\theta/\omega$,HR-GIXRD) - for characterization of crystallographic phases and residual strain; • Rocking curve profiles, reciprocal space map (RSM), pole figures - for characterization of single crystal bulk materials and epitaxial thin films and thin film structures; • X-ray reflectometry (XRR) - for evaluation of thickness, interface roughness and mass density of multilayer thin film structures; • Ultra small angle X-ray scattering (USAXS) - for particle/pore size analysis. Most of these techniques can be performed at 25 - 1100 C temperature to study the evolution of crystallographic phases or residual strain. SEM/AES imaging can be performed on surface or on cross-section – for investigation of thin film growth mode, porosity, particles shape and size, structural defects, composite material structure, etc. FTIR investigations can be carried out in absorption, transmission or attenuated total reflection (ATR) mode. **Representative parameters and accuracy** The Rigaku SmartLab diffractometer uses Cu K-α or Cu K-$\alpha_1$radiation. Possible X-ray beam widths: 0.2, 0.5, 2.0, 5.0 and 10 mm or 0.1 mm with micro-focus configuration (CBO-f). Available monochromator: Ge(220)x2, Ge(220)x4, Ge(440)x4. Available analyser: Ge(220)x2. Possible acquisition modes (HyPix 3000 detector): 0D, 1D or 2D, depending on the method of investigation. 2θ scanning range: 0°-160°. Goniometer resolution: 0.0001°. Sample stages: RxRy and X/Y (translation +/- 50 mm). Investigations versus temperature can be performed in the range of 25 °C - 1100 °C in vacuum or inert gas. The lateral resolution of OMICRON NanoSAM is ~ 6 nm at 10 keV beam energy and ~ 10 nm at 5 keV. In SEM mode the resolution is ~ 5 nm. Jasco FT-IR-6300 Spectrometer: Wavenumber range: 7800 – 150 cm-1; Wavenumber resolution: 0.07 cm-1 / ± 0.01 cm^{-1}. Beam Splitters: Ge/KBr (7800 – 400 cm^{-1}) and Mylar-5 (600 – 150 cm^{-1}); Detectors: DLATGS (7800 – 360 cm^{-1}) and DTGS(PE) (450 – 150 cm^{-1}); ATR crystals: Si (7800 – 1500 cm^{-1}, 475-150 cm^{-1}), Si/ZnSe (7800 – 550 cm^{-1})

Deliverables	The beneficiary will receive the measurement and processing data in a format mutually agreed and the measurement/analysis/interpretation report.
References	The Characteristics of Light (TiCrAl0.5NbCu)CxNy High-Entropy Coatings Deposited Using a HiPIMS/DCMS Technique, N.C. Zoita, M. Dinu, A.C. Parau, A. Lopez-Ortega, I. Pana, C.E.A. Grigorescu, M. Mondragon, A. Sobetkii, X. Almandoz, J.C. Rodriguez, A.A. Harb, A.E. Kiss, J.M. Izurrategi, Crystals, 13 (2023) 1-21, doi: 10.3390/cryst13111565 A comparative investigation of hetero-epitaxial TiC thin films deposited by magnetron sputtering using either hybrid DCMS/HiPIMS or reactive DCMS process, N.C. Zoita, M. Dinu, A.E. Kiss, C. Logofatu, M. Braic, Applied Surface Science 537 (2021) 1-10, doi: 10.1016/j.apsusc.2020.147903 Epitaxial GeSn obtained by high power impulse magnetron sputtering and the heterojunction with embedded GeSn nanocrystals for shortwave infrared detection, I. Dascalescu, N.C. Zoita, A. Slav, E. Matei, S. Iftimie, F. Comanescu, A.M. Lepadatu, C. Palade, S. Lazanu, D. Bucu, V.S. Teodorescu, M.L. Ciurea, M. Braic, T. Stoica, ACS Applied Materials & Interfaces (2020) 1-22, doi: 10.1021/acsami.0c06212 Patent RO135722 (B1)/2024 - Method for preparing high entropy alloys (HEA) as powder for plasma jet coatings and alloys obtained thereby, N.C. Zoita, C.E.A. Grigorescu, M. Dinu, A-M. Iordache, A.C. Parau, A.E. Kiss, I. Pana, L.R. Constantin, M.I. Rusu
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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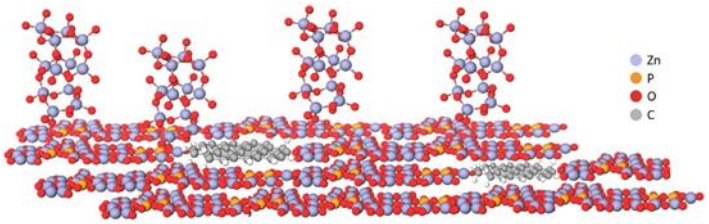
OPTOPSPINTRONICS

PREPARATION OF MULTILAYER COMPOSITE STRUCTURES

Type of the service	Scientific service
Targeted areas	• Transparent electrodes with applications in photovoltaic systems • Composites with photocatalytic properties for environmental applications • Composite structures for photovoltaic cell elements



ZnO-P_2O_5-rGO composite films

Short description	The sol-gel process involves conversion of monomers into a colloidal solution (sol) that acts as the precursor for an integrated network (or gel) of either discrete particles or network polymers. Typical precursors are metal alkoxides. Sol–gel process is used to produce composite structures. The sol-gel process is used to produce composite structures by forming a multicomponent sol composed of precursors of two or more elements with/without the addition of suspensions of solid compounds Inorganic thin films are prepared by coating on the substrate, followed by drying, thermal decomposition and annealing. The obtained composite structures benefit from the individual properties of each element leading to efficient materials for different applications.
Type of access	Not applicable
Access to service	Not applicable
Technical details	The equipment used for the synthesis are part of Solids Synthesis Laboratory (LaSIS): Sartorius Analytical Ballance Spin Coater: Laurell 650 Furnace type L1203M (Tmax 1200 0C) BINDER vacuum drying oven ASTEC Monair Fume Cabinet Eertis platform : https://eertis.eu/errf-2300-000h-2564

Deliverables	Composite films with thicknesses (50-200 nm) deposited on different substrates (glass, ITO, Si)
References	1. Effect of P_2O_5 content on luminescence of reduced graphene oxide doped ZnO-P_2O_5 nano -structured films prepared via the Sol–Gel Method, Ileana Cristina Vasiliu, Ana Violeta Filip , Irinela Chilibon , Mihail Elisa, Cristina Bartha, Victor Kuncser, Aurel Leca, Lucica Boroica, Bogdan Alexandru Sava, Roxana Trusca, Mihai Eftimie, Adrian Nicoara, *Materials* 2023, Vol.16(18), 6156; https://doi.org/10.3390/ma16186156 2. Films based on titanium (TiO_2) and phosphorus (P_2O_5) oxides modified with reduced graphene oxide (rGO) with controllable photocatalytic properties and process to obtain them, C. Vasiliu, A-M. Iordache, M. Elisa, I. Pana, B. A. Sava, L. Boroica, A-V. Filip, Patent application No, A/00342/2021 3. Zinc and phosphor oxide films modified with reduced graphene oxide with controllable fluorescent properties and process to obtain them, Patent application No A00568/2020, Ileana Cristina Vasiliu, Ana Maria Iordache, Mihail Elisa, Irinela Chilibon, Cristiana Eugenia Ana Grigorescu, Iordache Stefan Marian
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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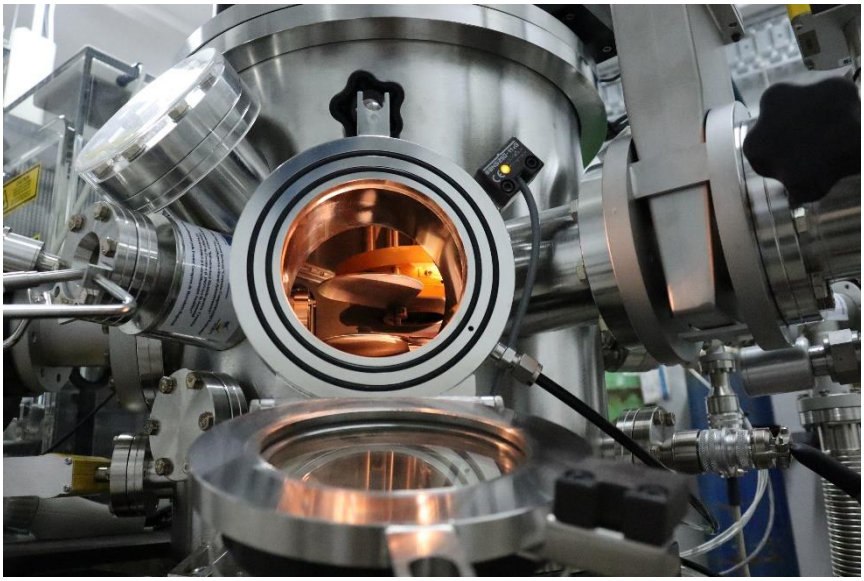
DEPOSITION ON NANOMETRIC THIN FILMS WITH PULSED LASER STATION

Type of the service	Scientific service
Targeted areas	• 1. Synthesis of thin and ultra-thin films • 2. Multilayer thin film depositions • 3. Heusler systems, dilute magnetic semiconductors



Short description	Pulsed Laser Deposition (PLD) of thin films is a physical thin layer deposition technique that uses a high power laser beam. It strikes a target of the material to be deposited, vaporizes the material, and moves it as a plasma to a substrate (eg, a silicon wafer facing the target), where it is deposited as a thin film. The process can be carried out both in high vacuum (10^-9 mbar) and in the presence of a gas such as oxygen, which is often used in the deposition of oxides. The processing of materials in the form of thin films facilitates the subsequent integration into various types of devices, being used in transistors, capacitors, non-volatile memories, sensors, thermo-, ferro- or piezoelectric materials and photovoltaic materials.
Type of access	Physical
Access to service	Does not apply.

Technical details	Pulse Laser Deposition Workstation (PLD2000)-PVD Products LTD (using 193 nm and 243nm lasers), equipped with RHEED system. Characteristics: - Maximum substrate size: Single 2-inch diameter or multiple small samples - Maximum substrate temperature: 1,000°C (in oxygen) for nontransparent substrates - Temperature uniformity: ± 8°C across a 2-inch diameter Si substrate at 800°C - Operating Pressure Range: 1 x 10-7 Torr base to 500 mTorr - Target Size: Six (6) 2-inch diameter targets by 6 mm thick with adapters for smaller sizes - Target to Substrate (Throw) Distance: 40-95 mm adjustable - Nominal Angle of incidence of the laser beam on target: 60 degrees - Laser: COMPEX 201 Excimer laser, Fluorine Version - Operational Wavelength: 248-nm (KrF) and 193 nm (ArF) - RHEED system to monitor the deposition of thin films The equipment used for the deposition of thin films is part of Solids Synthesis Laboratory (LaSIS): https://eertis.eu/errf-2300-000h-2564
Deliverables	Thin films with 30-400 nm thickness onto different metallic supports: Si, GaAs, InAs substrates
References	1. S. Azmi, A. Moujib, O.A. Layachi, E. Matei, A.C. Galca, M.Y. Zaki, M. Secu, M.I. Rusu, C.E.A. Grigorescu, E.M. Khoumri, Towards phase pure kesterite Cu2ZnSnS4 absorber layers growth via single step free sulfurization electrodeposition under a fix applied potential on Mo substrate, Journal of Alloys and Compounds, 842, 2020, 155821, *https://doi.org/10.1016/j.jallcom.2020.155821*. 2.C. E. A. GRIGORESCU, C.N. ZOITA, A. SOBETKII, A.-M. IORDACHE, S.-M. IORDACHE, C. R. STEFAN, M. I. RUSU, L. TORTET, A. TONETTO, R. NOTONIER, Multinary metal alloys of the Heusler, half-Heusler, dilute magnetic semiconductors, and high entropy families: how would spin make a choice?, Journal of Optoelectronics and Advanced Materials Vol. 22, Iss. 11-12, pp. 647-652 (2020)
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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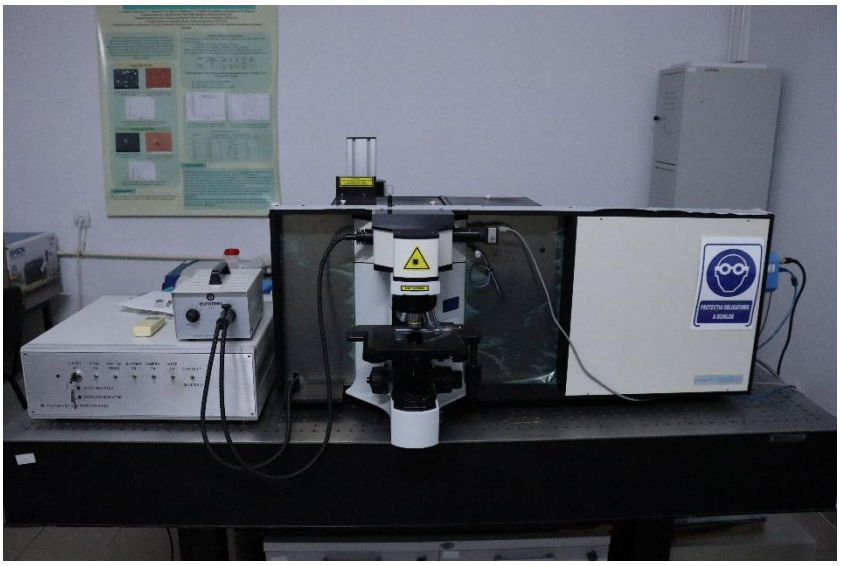
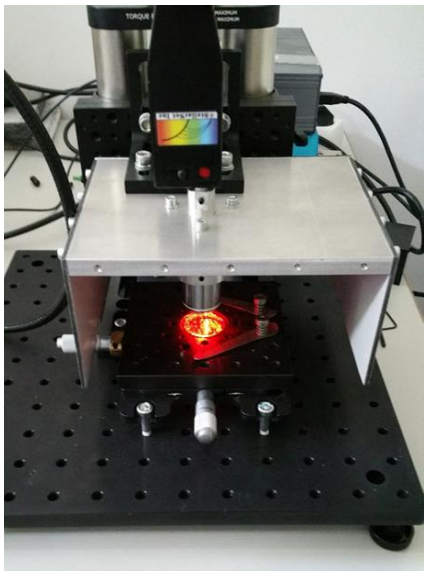
RAMAN INVESTIGATIONS OF BIOLOGICAL SAMPLES BASED ON SERS SUBSTRATES FOR THE DIAGNOSIS OF MALIGNANCY

Type of the service	Scientific service
Targeted areas	• 1. Analysis of biological samples in situ • 2. Characteristics They remain on biological substrates • 3. Biological sensors with applications in medicine





Short description	Raman spectroscopy is successfully applied for the ex vivo and in vivo characterization of various types of tissues, in order to diagnose biomedical problems, such as the early detection of cancers, monitoring the effect of different agents on the skin, determining the composition of atherosclerotic plaque and rapid identification of pathogenic microorganisms . Raman spectroscopy is based on Raman scattering, through which the composition of materials can be identified based on the information provided by the characteristic molecular vibrations. All the essential components of human tissues (proteins, nucleic acids and lipids) have corresponding characteristic peaks in the Raman spectra, which provide precise information on the health status of the tissues (eg: in damaged tissues, the composition and intracellular molecular structures vary from normal). During the research, approximately 800 biological samples obtained as a result of partnerships and collaborations with veterinary clinics were analyzed, the malignancy identification rate being 93%.
Type of access	Physical
Access to service	Does not apply.

Technical details	The equipment used is: Micro-Raman Spectrometer - LabRAM HR UV-Visible-NIR, Horiba Jobin –Yvon, with the characteristics: wavelength laser sources (633 nm, 514.5 nm and 488 nm, 785 nm), laser spot size of 1 μm^2, resolution of 0.5 to 1 cm^{-1} with a grating of 1800 g/mm, depending on the laser used. Uses: - characterization and identification of materials - micro-mapping and imaging (Raman and Photoluminescence). - analysis of microparticles (defects or contaminants) smaller than 1 micron. - structural determination (crystallinity, disorder, defects, orientation, stress, tensions, number of layers, etc.) - quantitative analysis The equipment used for sample characterization is part of the Materials Characterization Laboratory (LaOPT), eertis platform address: https://eertis.eu/errf-2300-000h-2564
Deliverables	Characterization report and malignant/non-malignant response of the analyzed sample.
References	1.C.E.A. Grigorescu et al., "Preparation and Study of Core Shell Fe3O4/Au Nanoparticles for Traceability of Blood Vessels and Biosensing by Surface Enhanced Raman Spectroscopy," 2020 22nd International Conference on Transparent Optical Networks (ICTON), Bari, Italy, 2020, pp. 1-4, doi: 10.1109/ICTON51198.2020.9203221. 2. Birtoiu IA, Rizea C, Togoe D, Munteanu RM, Micsa C, Rusu MI, Tautan M, Braic L, Scoicaru LO, Parau A, Becherescu-Barbu ND, Udrea MV, Tonetto A, Notonier R, Grigorescu CE. Diagnosing clean margins through Raman spectroscopy in human and animal mammary tumour surgery: a short review. Interface Focus. 2016 Dec 6;6(6):20160067. doi: 10.1098/rsfs.2016.0067
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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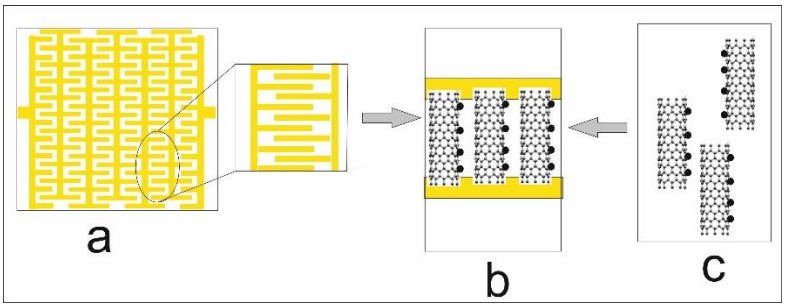
ELECTROCHEMICAL DEPOSITION OF THIN LAYERS ON CONDUCTIVE SUPPORT

Type of the srvice	Scientific service
Targeted areas	1. Synthesis of thin films 2. Thin film depositions 3. Electrochemical sensors



Short description	Electrodeposition of thin layers is performed by moving the charges in the electric field on the surface of a support. The technique is particularly important in the electrodeposition of semiconductor polymers because it also performs their electropolymerization. Depending on the material used and its properties, such as solubility, the materials are deposited on the electrode surface only after a certain number of molecules has been reached (estimated at 6-10 conjugated monomer molecules, but this number varies depending on the groups substituents, solvent, electrode material, polymerization potential, monomer concentration, temperature, etc.). After the deposition of the first thin polymer layer, the reactions between the charged oligomers lead to chain expansion and/or to the formation of chemical bonds between neighboring chains. These processes result in the insolubilization of the polymer film, even in solvents with high solubility properties for oligomers. The morphology of the deposited film depends mainly on its thickness and the reaction conditions. A rapid growth of the film leads to the formation of a "cauliflower" structure on the external surface. Lower deposition speeds (obtained in organic solvents) lead to the formation of flat layers, with film thicknesses in the submicrometric range.
Type of access	Physical
Access to service	Does not apply.

Technical details	The equipment used for electrochemical characterization is the Orygalis modular electrochemical system, composed of: a) Supply and interface module for multichannel potentiometers b) Potentiostat channel 0.5 A (General specifications: Auxiliary voltage: ± 20 V; Bias current: ±500 m A; Bias voltage: ±15 V; Current measurements: Range from 5 nA to 500 mA in 9 -intervals c) Impedance module for the potentiostat channel, frequency range: 100 µHz - 5 MHz (frequency resolution: 5 ppm) The Orygalis system is part of the Laboratory for the synthesis of solid materials (LaSIS), with the address platform eertis: https://eertis.eu/errf-2300-000h-2564
Deliverables	Electrochemical deposition report and thin layer materials (20-200 nm thickness) on conductive support
References	1.Iordache, S.-M.; Ionete, E.I.; Iordache, A.-M.; Stamatin, I.; Zoita, N.C.; Sobetkii, A.; Grigorescu, C.E.A. Functionalized Carbon Nanotubes for Chemical Sensing: Electrochemical Detection of Hydrogen Isotopes. Coatings 2021, 11, 968. https://doi.org/10.3390/coatings11080968 2. Stefan Marian Iordache, Eusebiu Ilarian Ionete, Ana Maria Iordache, Eugenia Tanasa, Ioan Stamatin, Cristiana Eugenia Ana Grigorescu, Pd-decorated CNT as sensitive material for applications in hydrogen isotopes sensing - Application as gas sensor, International Journal of Hydrogen Energy, 46, 18, 2021, 11015-11024, https://doi.org/10.1016/j.ijhydene.2020.12.193.
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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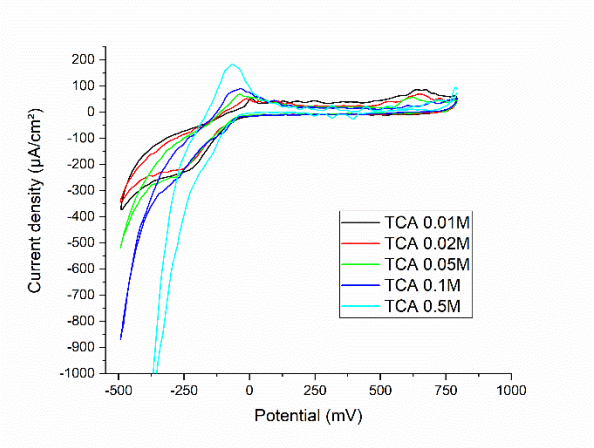
ELECTROCHEMICAL CHARACTERISTICS OF CONDUCTIVE AND SEMICONDUCTOR MATERIALS

Type of the srvice	Scientific service
Targeted areas	1. Electrochemical and impedance investigations 2. 2. Chemistry – characterization of new materials 3. 3. Physics - new electrochemical applications



Short description	Electrochemistry is a method of investigating materials that allows the evaluation of the composition and the kinetic processes of charge transfer. In the case of semiconducting organic materials, electropolymerization can be carried out (very important for semiconducting organic polymers such as aniline, pyrrole, thiophene, etc.). Recently, the electrosynthesis of quantum structures (quantum dots) can be realized either by direct deposition as in the case of metallic structures layered in ultra-thin films, or by electroetching, representative in the synthesis of porous silicon. From an analytical point of view, electrochemistry allows the quantification of conductive and semiconducting surfaces and interfaces, but also the analysis of the corrosion properties/processes of metal surfaces.
Type of access	Physical
Access to service	Does not apply

Technical details	The equipment used for electrochemical characterization is the Orygalis modular electrochemical system, composed of: a) Supply and interface module for multichannel potentiometers b) Potentiostat channel 0.5 A (General specifications: Auxiliary voltage: ± 20 V; Bias current: ±500 m A; Bias voltage: ±15 V; Current measurements: Range from 5 nA to 500 mA in 9 -intervals c) Impedance module for the potentiostat channel, frequency range: 100 µHz - 5 MHz (frequency resolution: 5 ppm) The Orygalis system is part of the Laboratory for the synthesis of solid materials (LaSIS), with the address platform eertis: https://eertis.eu/errf-2300-000h-2564
Deliverables	Characterization report of the investigation
References	1.Iordache, S.-M.; Iordache, A.-M.; Zubarev, A.; Caramizoiu, S.; Grigorescu, C.E.A.; Marinescu, S.; Giuglea, C. Spectro-Electrochemical Properties of A New Non-Enzymatic Modified Working Electrode Used for Histamine Assessment in the Diagnosis of Food Poisoning. Foods 2023, 12, 2908. https://doi.org/10.3390/foods12152908 2. Zubarev, A.; Cuzminschi, M.; Iordache, A.-M.; Iordache, S.-M.; Rizea, C.; Grigorescu, C.E.A.; Giuglea, C. Graphene-Based Sensor for the Detection of Cortisol for Stress Level Monitoring and Diagnostics. Diagnostics 2022, 12, 2593. https://doi.org/10.3390/diagnostics12112593
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
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CULTURAL HERITAGE

ELEMENTAL CHARACTERISATION OF PIGMENTS

Type of the service	Scientific service
Targeted areas	• Heritage Science • Elemental characterization and identification of pigments • Time framing of pigments

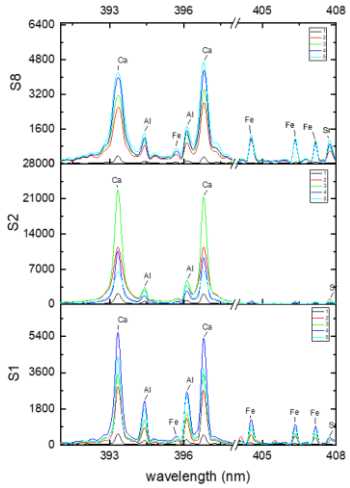
Short description	The service of elemental characterization of pigments can be accessed for non-invasive characterization of the constituent elements of pigments in easel/panel paintings. This service is based on elemental spectroscopy, in this case X-ray fluorescence spectroscopy. This allows for the accurate identification of even trace amounts of elements, and can, under certain circumstances, be used to time-frame the analysed works. Its advantage is that it allows a qualitative or semi-quantitative analysis, in real time, on any kind of surface, in any conditions (laboratory/in-situ), without requiring sampling, thus not harming in any way the object in question. The service can be useful for restorers and conservators, who can have a very precise idea about the inorganic materials used and can thus choose the most suitable solutions for the restoration or conservation of an easel/panel painting.
Type of access	Physical
Access to service	The elemental characterization of pigments in the easel/panel paintings can be carried out both at the provider's premises (INOE) and at the beneficiary's premises or at any location indicated by the beneficiary. Access is physical; if the service is provided to the beneficiary, it must ensure the necessary logistics for the location of the equipment and the performance of the experts' work (details to be determined after the application is submitted). INOE has the necessary space for the location and use of specific equipment, and beneficiaries who wish to access the service at a location other than the INOE headquarters must provide a separate space for analyses, without public access. Office space can be made available for analysis of results and discussions.

Technical details	**Laboratories and equipment involved** The service is based on equipment related to the Laboratory of applied archaeometry within INOE 2000 (ARHEA, https://eertis.eu/erlb-2300-001l-0337), a laboratory designed to carry out research, investigations, measurements and physico-chemical determinations for the characterization of cultural heritage assets, with the main aim of helping to preserve the national cultural heritage on a scientific basis. **Applicable standard methods and procedures** All methods and procedures respond to the recommendations for the conservation and restoration of heritage, according to the principles in force at national and international level[1,2,3]. The laboratory is authorized by the Ministry of Culture to carry out physico-chemical investigations on heritage objects (auth. 64/27.05.2014). **Representative parameters and accuracy** X-ray fluorescence (XRF) spectroscopy is performed with a portable Bruker TRACER III-SD equipment (https://eertis.eu/ereq-2300-008t-2865), which allows users to obtain reliable, reproducible, real-time results, for a diverse range of heritage applications. Representative parameters: voltage range: 0-45 kV; amperage range: 0-60 µA; optimal pulse density: 150000 cps; detector resolution: 145 eV at 100000 cps; the possibility of using filters for beam modulation.
Deliverables	Experimental report
References	The service has been on the market since 2015 and has been validated through numerous researches carried out on a wide range of materials the results obtained being integrated in multiple studies, such as: **Complementary investigations of two Lipovan-style icons**, L. Ghervase, I.M. Cortea, R. Radvan, L. Ratoiu, A. Chelmus, *Microchemical Journal* 2018, 138, 509-518; **Uncovering hidden jewels : an investigation of the pictorial layers of an 18th-century Taskin harpsichord**, I.M. Cortea, L. Ghervase, L. Ratoiu, M. Dinu, R. Radvan, *Heritage Science* 2020, 8(1), 55; **Unveiling the secrets of an artwork through non-invasive investigations-case study of a 19th-century female portrait,** A. Rauca, L. Ghervase, A. Berdie, M. Agachi, *Minerals* 2023, 13(9), 1193.
Terms of execution	The execution time and cost vary depending on the complexity of the order, the time required for data acquisition and processing, and the place where the service is performed (at the beneficiary or at the provider). Please contact us for details. The intellectual property rights regarding the results obtained from the provision of the service are established by mutual agreement, at the time of signing the contract.
Contact	Website: https://certo.inoe.ro Email: ghervase@inoe.ro

[1] http://www.coe.int/t/dg4/cultureheritage/heritage/Source/CDPATEP/Plenary_Session/CDPATEP_2009_17_EN.pdf
[2] https://www.icomos.org/en/resources/charters-and-texts
[3] CEN/TC 346 Conservation of Cultural Property; ISO/TC 349 Cultural Heritage Conservation

STRATIGRAPHIC ANALYSIS OF THE CHEMICAL COMPOSITION OF MULTILAYERED POLYCHROME OBJECTS – IN SITU, WITHOUT SAMPLING

Type of the service	Technological service
Targeted areas	• Heritage Science • Elemental and stratigraphic analysis of heritage objects • Provenance studies for archaeological objects



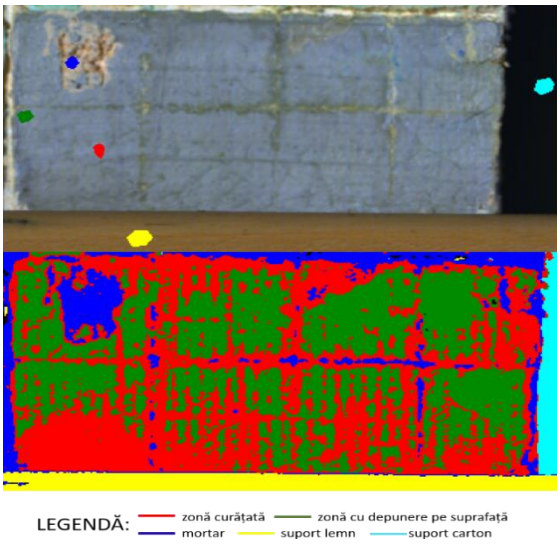
Short description	The micro-invasive stratigraphic analysis service can be accessed in order to characterize the constituent elements of multi-layered polychrome surfaces. This service is based on laser-induced breakdown spectroscopy (LIBS) that allows the express analysis of any type of material, in any environment. The method is based on laser-matter interaction, providing a qualitative, semi-quantitative or quantitative multi-elemental analysis, in-situ, without sampling. The resulting spectral data allow stratigraphic discrimination and can generate complex information about the original material, degradation mechanisms, hidden defects, hidden layers, repainting, previous interventions, technique, etc. By using advanced chemometric techniques, classifications can be obtained from LIBS data to determine the provenance of objects.
Type of access	Physical
Access to service	The stratigraphic analysis can be performed both at the provider's premises (INOE) and at the beneficiary's premises or at any location indicated by the beneficiary. Access is physical; if the service is provided at the beneficiary's location, he must ensure the necessary logistics for the equipment and the team (details to be determined after the application is submitted). INOE has dedicated laboratories for the use of specific equipment. Also, office space can be made available for analysis of results and discussions.

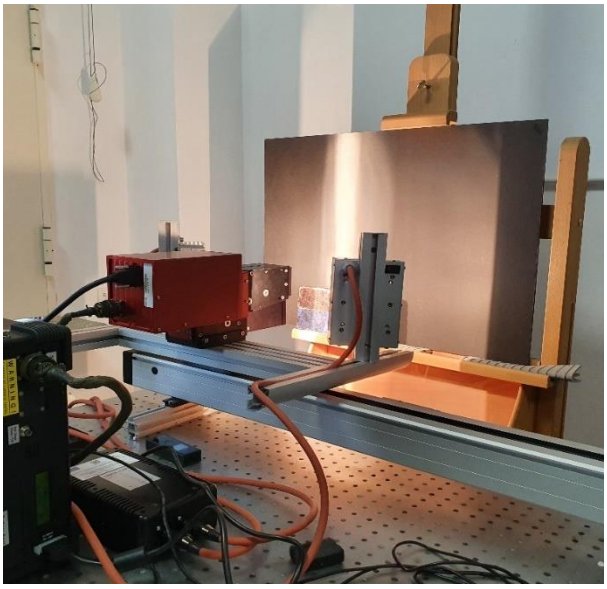
Technical details	**Laboratories and equipment involved** The service is based on equipment related to the mobile laboratory ART4Art within INOE 2000 (https://eertis.eu/erlb-2300-000p-8420), a laboratory designed to carry out research, investigations, measurements and physico-chemical determinations *in situ*, without sampling. **Applicable standard methods and procedures** All methods and procedures respond to the recommendations for the conservation and restoration of heritage, according to the principles in force at national and international level[4,5,6]. The laboratory is authorized by the Ministry of Culture to carry out physico-chemical investigations on heritage objects (auth. 64/27.05.2014). **Representative parameters and accuracy** The portable LIBS system consists of a Q-Switched Nd:YAG laser (λ = 1064 nm, pulse duration = 4 ns, E_{max}= 5 mJ and laser spot = 50 µm) and CCD spectrometers (spectral range: 190 nm - 950 nm, spectral resolution = 0.2 nm). The technique can be applied in *single pulse* or *double pulse* mode, depending on the nature and/or condition of the object to be investigated. https://eertis.eu/ereq-2300-008z-2868
Deliverables	Experimental report
References	The service has been on the market since 2019 and has been validated through numerous researches carried out on a wide range of materials, the results obtained being integrated in multiple studies, such as: M. Dinu, L.C. Ratoiu, C. Calin, G. Calin, **Multi-analytical investigations of the Medieval Turkish Bath from Golesti Open Air Museum**, *Buildings*, 13(2), 321, pp. 1-11 (2023); **Uncovering hidden jewels : an investigation of the pictorial layers of an 18th-century Taskin harpsichord**, I.M. Cortea, L. Ghervase, L. Ratoiu, M. Dinu, R. Radvan, *Heritage Science* 2020, 8(1), 55; U. Pacher, M. Dinu, T.O. Nagy, R. Radvan, W. Kautek, **Multiple wavelength stratigraphy by laser-induced breakdown spectroscopy of Ni-Co alloy coatings on steel**, *Spectrochimica Acta Part B: Atomic Spectroscopy*, Vol. 146, pp. 36-40 (2018), or patented: 125260/30.09.2011 - J. Striber, M.L. Angheluta, R. Radvan, M. Dinu (Simileanu), R. Savastru, **Device, method of stratigraphic analysis of the chemical composition of the superficial layers of works of art using the LIBS technique**; OSIM - A00638 / 09.10.2019 - M. Dinu, R. Rădvan, L.C. Ratoiu, **Complex method for identification, characterization and mapping of polychrome multilayer objects**, from macroscopic to microscopic level, OSIM A/00353 / 23.06.2020 - M. Dinu, R. Radvan, **Procedure for in situ LIBS analysis of the chemical composition of submerged objects**.
Terms of execution	The execution time and cost vary depending on the complexity of the order, the time required for data acquisition and processing, and the place where the service is performed (at the beneficiary or at the provider). Please contact us for more details. The intellectual property rights regarding the results obtained as a result of the provision of the service are established by mutual agreement, at the time of signing the contract.
Contact	Website: https://certo.inoe.ro Email: monica.dinu@inoe.ro

[4] http://www.coe.int/t/dg4/cultureheritage/heritage/Source/CDPATEP/Plenary_Session/CDPATEP_2009_17_EN.pdf
[5] https://www.icomos.org/en/resources/charters-and-texts
[6] CEN/TC 346 Conservation of Cultural Property; ISO/TC 349 Cultural Heritage Conservation

DETERMINATION OF BIODETERIOGENS AND ORGANIC RESIDUES ON THE SURFACE OF WALL PAINTINGS

Type of the service	Scientific service
Targeted areas	• Heritage Science • Validation of biocleaning processes of mural paintings • Identification of microbial metabolites and consolidant residues on surfaces





Short description	the service of non-invasive determination of organic residues and biodeteriogens on the surface of murals can be accessed within the MTO department of INOE 2000. This is a service that combines expertise based on molecular spectroscopy (Fourier Transform Infrared Spectroscopy – FTIR) with that based on hyperspectral imaging (in the SWIR range). The combination of the two fields allows a detailed, highly accurate identification and precise mapping of organic residues, such as those from smoke, wax, consolidants, or oil deposits, but also of the efficiency of the biocleaning processes carried out to remove these unwanted deposits. Its advantage is that is offers not only a qualitative determination of the presence or absence of certain materials, but that it can also accurately map the extent to which such materials are present on the given surface, thus identifying the boundaries of the cleaned area, highlighting the efficiency of biocleaning procedures applied. It can be most useful to restorers which choose to use alternative cleaning methods to the classic cleaning procedures which involve toxic solvents. The service can be applied for mural paintings, but also any other type of surface with polychromy.
Type of access	Physical
Access to service	The determination of biodeteriogens and organic residues on the surface of mural paintings can be performed both at the provider's premises (INOE) and at the beneficiary's premises or at any location indicated by the beneficiary. Access is physical; if the service is provided at the beneficiary's location, he must ensure the necessary

	logistics for the equipment and the team (details to be determined after the application is submitted). INOE has the space necessary for the location and use of specific equipment, as well as space for the storage and location of large pieces of heritage. Office space can be made available for analysis of results and discussions.
Technical details	**Laboratories and equipment involved** The service combines equipment related to two INOE laboratories, namely the Spectroscopy and Lasers Laboratory (Speclab, https://eertis.eu/erlb-2300-000c-8370) and the ARHEA laboratory (https://eertis.eu/erlb -2300-001l-0337). **Applicable standard methods and procedures** All methods and procedures respond to the recommendations for the conservation and restoration of heritage, according to the principles in force at national and international level[7,8,9]. The laboratory is authorized by the Ministry of Culture to carry out physico-chemical investigations on heritage objects (auth. 64/27.05.2014). **Representative parameters and accuracy** Fourier transform infrared spectroscopy is performed with a PerkinElmer SpectrumTwo (https://eertis.eu/ereq-2300-008l-2871) equipment, which allows users to set up simple and reliable IR solutions. The equipment has a wide range of plug-and-go accessories and application packages to ensure the best solution for a wide range of subjects. Representative parameters: measurement range: 8300 – 350 cm^{-1}; spectral resolution: 0.5 cm^{-1}; precision: below 0.01 cm^{-1} at 3000 cm^{-1}. Hyperspectral imaging (HSI) is performed with the HYSpex SWIR 384 equipment from NEO Norsk Elektro Optikk SAS (https://eertis.eu/ereq-2300-008u-2856). HSI combines digital imaging with spectroscopy. For each pixel in an image, the hyperspectral camera records the light intensity (radiance) for a large number of continuous spectral bands. Each pixel in the image thus contains a continuous spectrum (in brightness) and can be used to characterize objects with great precision and detail. Representative parameters: spectral range: 930-2500 nm; spatial pixels: 384; spectral channels: 288; FOV: 16°.
Deliverables	Experimental report
References	The service was tested in experiments carried out on laboratory samples, the results obtained being integrated in multiple studies, such as: **Brackish and Hypersaline Lakes as Potential Reservoir for Enzymes Involved in Decomposition of Organic Materials on Frescoes**, I. Gomoiu, R. Cojoc, R. Ruginescu, S. Neagu, M. Enache, G. Maria, M. Dumbravician, I. Olteanu, R. Radvan, L.C. Ratoiu, V. Atanassova, L. Ghervase, *Fermentation* 2022, 8, 462. https://doi.org/10.3390/fermentation8090462; **Mural cleaning guide (from mechanical to ecological cleaning)**, I. Gomoiu, L. Ghervase, I. Mohanu, M. Dumbrăvician, *Ed. Unarte*, 2022, ISBN 978-606-720-166-6.
Terms of execution	The execution time and cost vary depending on the complexity of the order, the time required for data acquisition and processing, and the place where the service is performed (at the beneficiary or at the provider). Please contact us for details. The intellectual property rights regarding the results obtained from the provision of the service are established by mutual agreement, at the time of signing the contract.
Contact	Website: https://certo.inoe.ro Email: ghervase@inoe.ro

[7] http://www.coe.int/t/dg4/cultureheritage/heritage/Source/CDPATEP/Plenary_Session/CDPATEP_2009_17_EN.pdf
[8] https://www.icomos.org/en/resources/charters-and-texts
[9] CEN/TC 346 Conservation of Cultural Property; ISO/TC 349 Cultural Heritage Conservation

ACCELERATED AGEING OF CONTEMPORARY MATERIALS

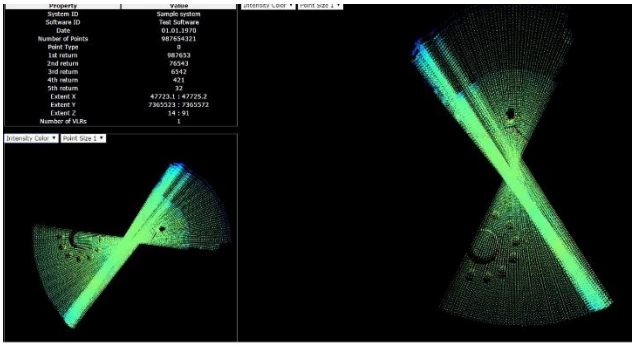
Type of the service	Scientific service
Targeted areas	• Heritage science • Preventive Conservation • Identification of changes in materials subjected to stressful environmental factors

Short description	Within the MTO department of INOE 2000, the accelerated ageing service can be accessed for different types of materials with applicability in the field of heritage sciences. This service is based on the artificial ageing of materials or objects, by exposure, in repeated cycles, to the main degradation factors, namely: UV radiation, heat and humidity. By combining these factors, an effect similar to natural processes can be obtained, in a much shorter time, being particularly useful for studies related to the effect of environmental factors on the behavior and properties of materials. The advantage of using this service is mainly in reducing the waiting time to assess the impact of environmental factors on a material (being able to simulate the action of several years outdoors in a few days), but also in providing a safe environment, without risk, in which a material can be tested, this being especially useful in the case of materials for restoration, for which it is possible to test not only their behavior over time, but also their compatibility with the original materials, thus being able to evaluate, the effects in the long term of certain restoration or conservation treatments and being able to make estimates regarding the lifetime of a material.
Type of access	Physical – fixed facility
Access to service	The accelerated aging of materials service can be accessed at the provider's headquarters (INOE). Access is physical (the beneficiary accompanies the operator to the INOE laboratories or can assist the operator). INOE has laboratories dedicated to the use of specific equipment,, as well as space for the storage and location of materials

	or samples that need to be aged. Office space can be made available for analysis of results and discussions.
Technical details	**Laboratories and equipment involved** The service combines equipment related to the Laboratory of Spectroscopy and Lasers (Speclab, https://eertis.eu/erlb-2300-000c-8370) within INOE. **Applicable standard methods and procedures**: with regard to the accelerated aging of heritage materials, there are multiple standards that simulate certain environmental scenarios and may be useful for establishing working parameters, such as: ISO 5630-3:1996 (for paper and cardboard), ASTM D5312:2013 (for rocks), ISO 17228:2015, ASTM D8137-18(2023) (for leather) and other similar ones **Representative parameters and accuracy** The climate chamber model ICH260eco (Memmert) (https://eertis.eu/ereq-2400-011m-9635), allows the exposure of materials to variations in temperature and relative humidity. Representative parameters: temperature range: -10 ÷ 60^{o}C without humidity, or +10÷+60^{o}C with humidity; relative humidity range: 10-80% RH; ventilation: 10-100%; volume 256 l. The UV Exposure Chamber – QUV-SE (Q-Lab Corporation) (https://eertis.eu/ereq-2400-011h-9637) can reproduce the action caused by sunlight, rain and dew (simulating dew and rain with moisture in condensation). The UV chamber allows materials to be exposed to alternating cycles of UV radiation and humidity at controlled, elevated temperatures. Representative parameters: three types of lamps (UVA-340 nm, UVA-351 nm, UVB-313 nm); QUV Solar Eye irradiance sensor calibration; exposure time, humidity, irradiance, temperature adjustable.
Deliverables	Research report
References	The service has been on the market since 2021 and has been validated through numerous researches carried out on a wide range of materials, the results obtained being integrated in multiple studies, such as: **Color changes in the artwork materials aged by UV radiation,** N. Herascu, M. Simileanu, R. Radvan, Rom. Rep. Phys., Vol. 60, No. 1, pp. 95-103 (2008), ISSN 1221-145143; **Characterization of contemporary bast textiles and investigation of induced aging effects for complex Cultural Heritage restoration applications**, M. Dinu, C. Radulescu, R. Radvan, I.M. Cortea, Ind. Textila, Vol. 66, No. 6, pp. 3535-359 (2015); **Guide to cleaning mural paintings (from mechanical to ecological cleaning),** I. Gomoiu, L. Ghervase, I. Mohanu, M. Dumbrăvician, Ed. Unarte, 2022, ISBN 978-606-720-166-6.
Terms of execution	The execution time and cost vary depending on the complexity of the order, the time required for aging and further processing of the data. Please contact us for details. The intellectual property rights regarding the results obtained as a result of the provision of the service are established by mutual agreement, at the time of signing the contract.
Contact	Website: https://certo.inoe.ro/ Email: certo@inoe.ro

MULTILAYER DIGITAL PACKAGE FOR 3D VISUALIZATION OF DATA

Type of the service	Technological service
Targeted areas	• Heritage Sciences • Imaging analyses • Prediction of degradations



Short description	The service provides the generation of a digital visualization package of data obtained from complementary investigations, through an interactive graphical interface. As a virtual environment, it facilitates access and viewing for the user (whether a conservator, historian or just interested public). The usefulness of this high-tech service concerns three main aspects: observing the evolution of the state of preservation over given periods of time; prediction of the degradations of the components of the heritage object based on previous observations; analysis and multilayer characterization of the studied surface.
Type of access	Virtual/Digital
Access to service	The service can be performed both at INOE's or the beneficiary's premises. Access is virtual/digital; if the service is provided at the beneficiary's location, it must have the necessary logistics (details to be determined after the application is submitted). INOE has the necessary resources for data hosting and security.

Technical details	**Laboratories and equipment involved** The service is based on equipment related to the digital laboratory within INOE 2000 (https://eertis.eu/erlb-2300-000x-8428), a laboratory designed to generate FAIR digital data packages and to provide virtual access to them. The laboratory serves the national DATAFUSIONART infrastructure. **Applicable standard methods and procedures** All methods and procedures respond to the recommendations for the conservation and restoration of heritage, according to the principles in force at national and international level[10,11,12]. The laboratory is authorized by the Ministry of Culture to carry out physico-chemical investigations on heritage objects (auth. 64/27.05.2014). **Representative parameters and accuracy** The techniques that can be corroborated: 3D laser scanning / photogrammetry, LIF scanning, LDV, multispectral and hyperspectral imaging, thermal imaging, X-ray radiology, colorimetry and microscopy - for certain areas of interest. Each pixel of the 2D images, recorded as intensity distribution maps, is associated with the group of angular points corresponding to that pixel in the 3D digital model of the scanned images. In the case of stereo photos, the 3D model obtained using this technology will be directly associated. Based on these data correlations the 3D model of the area will be created and it will be glued to the other areas to create the final 3D digital model of the object.
Deliverables	Experimental report
References	https://sketchfab.com/certo/models
Terms of execution	The execution time and cost vary depending on the complexity of the order, the time required for data acquisition and processing, and the place where the service is performed (at the beneficiary or at the provider). Please contact us for more details. The intellectual property rights regarding the results obtained as a result of the provision of the service are established by mutual agreement, at the time of signing the contract.
Contact	Website: https://certo.inoe.ro Email: certo@inoe.ro

[10] http://www.coe.int/t/dg4/cultureheritage/heritage/Source/CDPATEP/Plenary_Session/CDPATEP_2009_17_EN.pdf
[11] https://www.icomos.org/en/resources/charters-and-texts
[12] CEN/TC 346 Conservation of Cultural Property; ISO/TC 349 Cultural Heritage Conservation

ENVIRONMENT, CLIMATE AND BIORESOURCES

FINE PARTICLE CONCENTRATION AND SOURCES AT NEAR SURFACE

Type of the service	Scientific service
Targeted areas	• Air quality • Atmospheric research • Warning systems for near surface pollution events

Short description	INOE operates the national observational facility, RADO-Bucharest, within the pan-European research infrastructure ACTRIS ERIC, which includes three components, among them the "in-situ aerosol" component. This component is responsible for quasi-continuous measurements of concentrations, physical and chemical properties of suspended particles of various sizes (PM1, PM2.5 and PM10 - particles with a diameter smaller than 1, 2.5 or 10 µm) under optimal conditions and fulfilling the data quality parameters. The service includes the identification of the suspended particles variability and their contributing sources in the Bucharest-Ilfov area. Variability of concentrations of black carbon and ultrafine particles, necessary to identify the suspended particle effects on health and the environment, can be determined among other fine particles characteristics.
Type of access	Remote
Access to service	This service is based on data access and post-processing of the data in order to identify fine particle sources, as well as interpretation of related scientific results. At the INOE premises exists both the instruments and the IT tools necessary to carry out the scientific service. Specific measurement sequences can be defined depending on the need of the study related to air quality (details are determined after the request is submitted).

Technical details	**Laboratories and equipment involved** Several in-situ instruments, part of the aerosol in-situ laboratory within the Remote Sensing department of INOE (https://eertis.eu/erlb-2300-000p-6327), can be involved during the service: aethalometer with 7 wavelengths, scanning mobility particle sizer, aerosol chemical speciation monitor, optical particle counter, etc. The equipment's performances and stability are checked according to the standards of the pan-European infrastructure. **Applicable standard methods and procedures** The equipment's from aerosol in-situ laboratory and consequent data follow ACTRIS standard procedures and tests (https://www.actris-ecac.eu/measurement-guidelines.html). **Representative parameters and accuracy** The aethalometer measures the suspended particles absorption at 7 wavelengths by collecting the aerosol on a band filter, deriving the total black carbon concentration. Due to the differentiated optical absorption, separations can be made between the different types of carbonaceous aerosols emitted by combustion (fossil fuel burning or biomass burning). Measurements at 7 wavelengths allow a separation of these components, providing real-time apportionment of aerosol sources and identification of possible origin. The aerosol chemical speciation monitor measures on 30 minutes average interval the submicron non-refractory particle species, pin pointing the variability of organic species, sulfates, nitrates, ammonium and chlorides. The chemical composition of the particles is closely related to the type of aerosol and their source of origin. The scanning mobility particle sizer determines the electrical mobility diameter of particles between 10 and 1000 nm in size, being able to determine the size and mass distributions of aerosols, as well as their variability over time. The optical particle counter detects the optical size of particles in the range of 0.25-32 µm and the mass concentration of PM1, PM2.5, PM10.
Deliverables	Report on concentrations and/or sources of fine particles in the Bucharest-Ilfov area
References	• https://riurbans.eu/wp-content/uploads/2023/06/RI-URBANS_D22_D4_1.pdf • https://www.atmo-access.eu/observational-platforms/ • Savadkoohi et al, The variability of mass concentrations and source apportionment analysis of equivalent black carbon across urban Europe, Environment International, 178, 2023, 108081 https://doi.org/10.1016/j.envint.2023.108081 • Chen, G. et al., European aerosol phenomenology - 8: Harmonised source apportionment of organic aerosol using 22 Year-long ACSM/AMS datasets. Environment international, 166, 107325, 2022, https://doi.org/10.1016/j.envint.2022.107325
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://actris-nf-labelling.out.ocp.fmi.fi/facility/99 Email: jeni@inoe.ro

AEROSOL PROFILING USING ACTIVE REMOTE SENSING LIDAR SYSTEMS

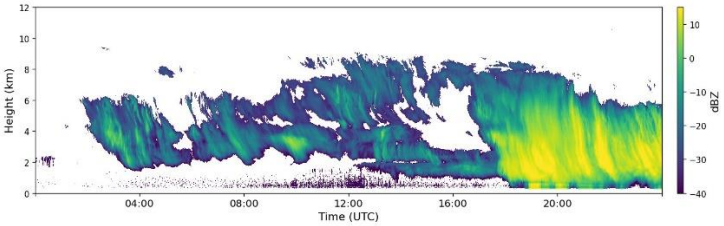
Type of the service	Scientific service
Targeted areas	• Atmospheric research • Design and implementation of lidar systems for aerosol detection • Warning systems for high altitude particle intrusions

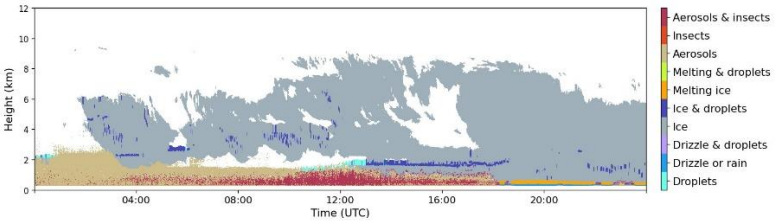
Short description	Aerosol profile observations are conducted using automatic low-power lidars and high-power lidars. Low-power lidars are used to provide information on aerosol layering and attenuated backscatter at a single wavelength, which is useful for studying fog formation and cloud classification. High-power lidars, due to their higher power, provide quantitative information on aerosol optical properties, such as the aerosol backscatter coefficient and aerosol extinction coefficient. Aerosol column observations are covered by automatic sun/sky/lunar photometers, which provide aerosol properties both directly and indirectly. The synergies between aerosol profile and column observations are being developed within ACTRIS to provide higher-level aerosol variables, such as extinction, backscatter, and aerosol mass concentration. Through these activities, INOE significantly contributes to advancing aerosol remote sensing research and application both nationally and internationally.
Type of access	Remote
Access to service	INOE can provide aerosol profiling services to support atmospheric research, intercomparisons, calibrations, as well as warning services for high-altitude particle intrusions. By utilizing high-power lidars and automatic photometers, INOE delivers precise data on the optical properties of aerosols, including backscatter and extinction coefficients, and linear depolarization ratio. These measurements are crucial for atmospheric research, offering detailed insights into aerosol layering and dynamics. In intercomparison and calibration activities, INOE employs reference systems to ensure data accuracy and consistency. Additionally, aerosol profiles enable the detection and monitoring of high-altitude particle intrusions, facilitating early warning services for the protection of public health and the environment.

Technical details	**Laboratories and equipment involved** The two reference lidar systems are part of the aerosol remote sensing laboratory within INOE's Remote Sensing department (https://eertis.eu/errf-2300-000u-1746). The ALPHA reference lidar system is a multi-wavelength, multi-depolarization, Raman and high spectral resolution system with continuous operation. This is used when very high accuracy is required or when the system to be tested has channels in the ALPHA wavelength spectrum. The MILI reference lidar system is an ultraviolet scanning system that can also be used in locations where there is a risk of exposure. **Applicable standard methods and procedures** For calibration by direct comparison of aerosol lidar systems with reference lidar systems simultaneous observations are performed, ACTRIS standard procedures and tests are applied (https://www.actris.eu/sites/default/files/inline-files/QAPs- CARS-Jan2024-v01-rev12.pdf), results are analyzed and recommendations for improvement are made. **Representative parameters and accuracy** The ALPHA reference lidar system has a dynamic range of 0.3-20 km, depending on the atmospheric transmission, with a spatial resolution of 3.75 m. Outputs: backscatter coefficients at 1064, 532 and 355 nm, coefficients of extinction by Raman detection at 1064, 532, and 355 nm, extinction coefficient at 532 nm by high spectral resolution detection, and linear particle depolarization ratio s at 1064, 532, and 355 nm. The MILI reference system has a UV laser emission wavelength of 355 nm and a dynamic range of 1-15 km, depending on atmospheric transmission, with a spatial resolution of 7.5 m. Outputs: backscatter coefficient at 355 nm and the linear particle depolarization ratio at 355 nm in each scan direction.
Deliverables	Measurement report + collected data + optical products + time series of atmospheric profiles + data interpretation
References	https://environment.inoe.ro/category/38/active-remote-sensing-lab Paschou, P., Siomos, N., Tsekeri, A., Louridas, A., Georgoussis, G., Freudenthaler, V., Binietoglou, I., Tsaknakis, G., Tavernarakis, A., Evangelatos, C., von Bismarck, J., Kanitz, T., Meleti, C., Marinou, E., and Amiridis, V.: The eVe reference polarisation lidar system for the calibration and validation of the Aeolus L2A product, Atmos. Meas. Tech., 15, 2299–2323, https://doi.org/10.5194/amt-15-2299-2022, 2022
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://www.actris.eu/topical-centre/cars E-mail: livio@inoe.ro

CHARACTERISATION OF CLOUDS BY REMOTE SENSING

Type of the service	Scientific service
Targeted areas	• Solar energy applications - consultancy for determining locations for solar panels depending on the variability of the micro and macro physical properties of the clouds • Agriculture – studies related to the variability of cloud/precipitation properties for decisions in cultivated field crops • Calibration/Validation of satellite measurements





Short description	1. Solar energy applications - consultancy for determining locations for solar panels depending on the variability of the micro and macro physical properties of the clouds 2. Precision agriculture – studies related to the characterization of the micro and macro physical properties of clouds for decisions in cultivated field crops 3. Calibration/Validation of satellite measurements of the European Space Agency, EUMESAT, NASA, JAXA
Type of access	Hybrid
Access to service	INOE can offer profiling services for the micro and macro physical properties of clouds. Access to data as well as their interpretation can be carried out in a hybrid system depending on the applicability of the desired service. The characterization studies of the micro and macro physical properties of the clouds can be done remotely as well as at the physical location of our station. For the calibration/validation exercise of satellite measurements, the service is remote, with INOE having the necessary applications for comparing ground measurements with satellite ones. Also, a specific measurement plan can be defined for the scientific application in question.

Technical details	**Laboratories and equipment involved** The cloud remote sensing laboratory in INOE is part of the international network ACTRIS Center for Cloud Remote Sensing ACTRIS-CCRES: https://www.actris.eu/topical-centre/ccres Main equipment used: Cloud Radar-Mira 35 GHz https://instrumentdb.out.ocp.fmi.fi/instrument/d98f6fd2-bec9-4e5e-b1d3-5ca422529215 **Applicable standard methods and procedures** For calibration and operation, we are applying the ACTRIS CCRES standard procedures and tests available at: https://www.actris.eu/sites/default/files/inline-files/CCRES%20Requirements%2010112022.docx.pdf https://www.actris.eu/topical-centre/ccres/doppler-cloud-radar **Representative parameters and accuracy** The vertical structure of clouds in an atmospheric column, using the temporal dimension to produce the equivalent of a two-dimensional section through the three-dimensional atmosphere is given by the following parameters: • Radar reflectivity. • Doppler velocity • Altitude of cloud base. • Cloud thickness. • Frequency of appearance of clouds The resolution required to capture cloud structure requires the use of active remote sensing in the form of cloud radar measurements. It provides the full Doppler spectrum, along with the first 3 moments of the Doppler spectrum (reflectivity, Doppler velocity, and spectral width) and the linear depolarization ratio. The minimum sensitivity is -60 dBZ at 1 km for an integration time of 10 seconds, allowing the detection of almost all radiatively significant ice clouds under non-precipitating conditions.
Deliverables	Scientific report/cal/val report
References	Pîrloagă, R.; Ene, D.; Boldeanu, M.; Antonescu, B.; O'Connor, E.J.; Ştefan, S. Ground-Based Measurements of Cloud Properties at the Bucharest–Măgurele Cloudnet Station: First Results. Atmosphere 2022, 13, 1445. https://doi.org/10.3390/atmos13091445 Silke Gross DLR, Science and Cal/Val Campaigns – Overview https://az659834.vo.msecnd.net/eventsairwesteuprod/production-nikal-public/1c6ca5307f2044f8b2573a68e4a83e53 Graeme Stephens, NASA Cloudsat and Calipso presentation https://az659834.vo.msecnd.net/eventsairwesteuprod/production-nikal-public/77a3f8999f48401c952a5ea4592aeaa3 Research looks at how cloud cover affects corn growth- https://www.farmprogress.com/corn/research-looks-at-how-cloud-cover-affects-corn-growth Marus, Michael. 2015. Cloud Cover: a favourable forecast for open access in agriculture. ICT Update (79) 22.

	Why clouds affect our solar energy https://www.actionnews5.com/2022/02/04/breakdown-why-clouds-affect-our-solar-energy/ Yang, J., Yi, B., Wang, S. et al. Diverse cloud and aerosol impacts on solar photovoltaic potential in southern China and northern India. Sci Rep 12, 19671 (2022). https://doi.org/10.1038/s41598-022-24208-3
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://cloudnet.fmi.fi/search/visualizations?site=bucharest Email: anca@inoe.ro

AIR QUALITY AND CAL/VAL STUDIES USING PASSIVE REMOTE SENSING

Type of the service	Scientific Service
Targeted areas	• Atmospheric Science • Air quality studies • Cal/val activities

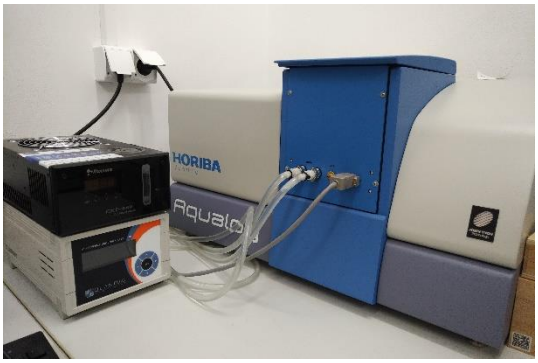
Short description	INOE is part of two international networks for measuring and quantifying the column densities of greenhouse and trace gases, the Collaborative Carbon Column Observing Network (COCCON) and the Pandonia Global Network (PGN), respectively. Within these two networks, measurements and studies are carried out regarding air quality, as well as continuous calibration/validation activities for Earth Observation satellite missions for ESA, EUMETSAT, and EC (e.g., Sentinel 5-P - TROPOMI). The COCCON network utilizes a new type of portable FTIR spectrometer developed by KIT in collaboration with Bruker Optics (Ettlingen, Germany) for measuring the main greenhouse gases (i.e., CH_4, CO_2, H_2O, and CO).

	The main instrument developed by PGN is a calibrated, standardized, and verified MAX-DOAS system for air quality studies and satellite validation measuring NO_2, O_3, SO_2, and HCHCO.
Type of access	Hybrid
Access to service	Access to and interpretation of data can be done in a hybrid system depending on the applicability of the desired service. Air quality studies can be conducted both remotely and at the physical location of our stations. For the calibration/validation exercise of satellite measurements, the service is remote, with INOE having the necessary applications to compare ground and satellite measurements. For air quality studies, MAX-DOAS measurement experiments can be defined with specific measurement routines depending on zenith and azimuth angles, as well as integration times for spectra recorded with CCD detectors. A specific measurement plan can also be defined for the scientific application in question. The portable FTIR system can also be used physically in campaigns at different locations than the fixed station.
Technical details	**Laboratories and equipment involved** The two passive remote sensing systems for atmospheric gases are part of INOE's Remote Sensing department (https://eertis.eu/ereq-2300-005j-2875). The COCCON station represents a portable compact and lightweight EM27/SUN spectrometer, making it easy to deploy in a variety of environments worldwide. This facilitates a truly collaborative approach to data collection, with multiple research institutions and organizations contributing to the network's comprehensive coverage. The resulting data provides critical information about the distribution, sources, and sinks of greenhouse gases, essential for understanding and addressing climate change. The MAX-DOAS - Pandora system is designed to be mounted on drones, or fixed platforms, offering flexibility in deployment and monitoring of industrial sites. By continuously scanning the targeted areas, Pandora accurately identifies and locates emission sources, providing valuable information for reducing environmental impact. **Applicable standard methods and procedures** Within the COCCON network, for each instrument, simultaneous measurements of atmospheric spectra are performed alongside the Bruker IF125HR high-resolution spectrometer to determine the instrument-specific residual calibration factors for each species. Continuous quality control/quality assurance (QC/QA) activities include a correct optical alignment, laboratory open-path measurements for the determination of the instrumental line shape (ILS) parameters. The MAX-DOAS systems within PGN provide real-time, standardized, calibrated, and verified air quality data along with associated uncertainty values. In the context of satellite validation, PGN datasets represent Fiducial Reference Measurements. PGN also seeks to coordinate and implement network standards regarding common algorithms and data processing, instrument operating routines, quality control, real-time data processing, and data archiving. More details on standard methods and procedures are described by Cede et al., 2021. **Representative parameters and accuracy** For comparing observations collected with different remote sensing instruments or for comparing remote sensing observations with model data, the limited capability of

	the remote sensing observation in reconstructing the actual atmospheric state needs to be taken into account. In general, this requires the a-priori profile which was used for the retrieval and the averaging kernel matrix, which specifies the loss of vertical resolution (fine vertical details of the actual trace gas profile cannot be resolved) and sensitivity (the retrieved total column differs from the actual column amount) (e.g. Rodgers, 2003). In the case of COCCON, the spectrometers used be the network offer only a low spectral resolution of 0.5 cm-1. Therefore, performing a simple least squares fit by scaling retrieval of the a-priori profile is generally appropriate.
Deliverables	Study report; Validation report.
References	Frey, M., et.al.: Calibration and instrumental line shape characterization of a set of portable FTIR spectrometers for detecting greenhouse gas emissions, doi: 10.5194/amt-8-3047-2015, 2015. Frey, M., et.al.: Building the COllaborative Carbon Column Observing Network: long-term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer, DOI: 10.5194/amt-12-1513-2019. Alexander Cede, Manual for Blick Software Suit 1.8, LuftBlick Earth Observation Technologies, 2018, https://www.pandonia-global-network.org/wp-content/uploads/2021/09/BlickSoftwareSuite_Manual_v1-8-4.pdf Rodgers, C. D., and B. J. Connor, Intercomparison of remote sounding instruments, doi:10.1029/2002JD002299. Cede, A., Fiducial Reference Measurements for Air Quality, https://www.pandonia-global-network.org/wp-content/uploads/2021/01/PGN_DataProducts_Readme_v1-8-3.pdf *www.imk-asf.kit.edu/english/3224.php* https://www.pandonia-global-network.org/ https://www.imk-asf.kit.edu/english/COCCON.php
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://environment.inoe.ro/ Email: alexandru.dandocsi@inoe.ro

CHARACTERIZATION OF ORGANIC MATTER FROM AQUATIC SYSTEMS

Type of the service	Scientific service
Targeted areas	• Ecosystem health • Water pollution • Anthropogenic impact



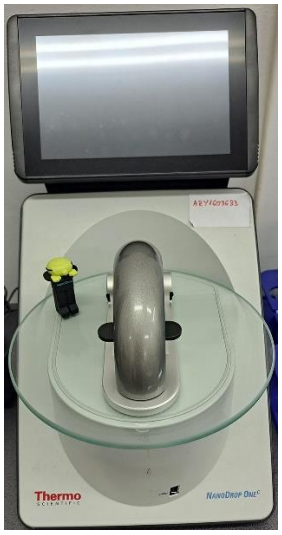
Short description	INOE has one of the best equipped laboratories used for the research of aquatic ecosystem quality, the MOCA laboratory, which is part of the Research Infrastructure Roadmap since 2021, aiming to study the anthropogenic impact on the quality of aquatic ecosystems. To this end, modern spectroscopic techniques and state-o-the-art infrastructure are being used, capable of providing fast and accurate information on the degree of pollutant contamination of aquatic systems. Thus, the core concept is to offer qualitative and quantitative information on the quality of aquatic systems using fluorescence spectroscopy, as well as chromatography and microbiology techniques. MOCA possesses a unique combination of high-end instruments for the characterization of aquatic compounds, such as dissolved organic matter, polyaromatic hydrocarbons, or natural and artificial nanoparticles. The service includes *in situ* tests and laboratory measurements, as well as the interpretation and analysis of the obtained results for the characterization of organic matter from the specified aquatic systems.
Type of access	Physical
Access to service	The *in situ* monitoring of the physical parameters, as well as the sample collection procedure, necessary for the *ex situ* measurements, are carried out by INOE experts who accompany and operate the specific equipment, at the demander's location. For this type of measurements and procedures, the demander must provide the logistic necessary for the placement of all the portable sensors and to ensure the access for the experts on field in order to have a smooth operation of sample collection and preservation (details to be determined after the request is submitted). INOE ensures the smooth operation of the MOCA laboratory, at the institution headquarters, and provides all the necessary materials and supplies to perform all the laboratory tests.

Technical details	**Laboratories and equipment involved** The equipment used for the characterization of aquatic systems and the nanoparticles detected within are part of the laboratory for optospectral methods for water quality assessment (MOCA), which is part of the Department of Constructive and Technological Engineering, Lasers & Fiber Optics Communications (https://eertis.eu/errf-2300-000s-2713). For the **tests performed *in situ***, the service dictates the use of the SMF4 portable fluorimeter, as well as the following portable sensors: Multiparametric probe, UviLux BOD, UviLux Tryptophan. With regard to the **tests performed in the laboratory** after the samples are collected by the INOE experts, the service mandates the use of Edinburgh Instruments FLS 920, Jasco FP8200 and Aqualog UV-800 spectrofluorimeters **Applicable standard methods and procedures** To carry out the tests and experiments for the *in situ* and *ex situ* monitoring of the aquatic ecosystems mentioned in the request, the standard procedures used and recognized within INOE for the MOCA laboratory for the characterization of aquatic environments are applied. Upon the completion of tests and experiments, the obtained results are interpreted and an extensive report is drawn up full with all the explanation needed and the observations and recommendations of the INOE experts. **Representative parameters and accuracy** The SMF4 portable fluorimeter is used for the quantification of tryptophan, which is important for the determination of biochemical oxygen demand. Outputs: rapid identification of pollution caused by the presence of faecal matter in the aquatic systems. The portable sensors – EXO2 multiparametric probe, UviLux BOD and UviLux Tryptophan are used to determine physical parameters such as pH, conductivity, turbidity, dissolved oxygen, total algae, protein matter, humic substances and total dissolved solids. Outputs: quantitative and qualitative data on the physical parameters that characterize the state of the aquatic systems. Edinburgh Instruments FLS 920, Jasco FP8200 and Aqualog UV-800 spectrofluorimeters are used to characterize natural organic matter and organic pollutants. Outputs: excitation-emission matrices used to identify and characterize the presence of different types of pollutants from the aquatic systems.
Deliverables	Extensive report in the state of organic matter present in the specified aquatic systems, along with recommendations from our experts regarding the degree of water pollution.
References	• E.M. Carstea, S. Mounier, R. Redon, C.L. Popa, Role of non-fluorescent chromophores in inner filter effect correction and PARAFAC decomposition, Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 229, 117878 (2020) • C.L. Popa, S.I. Dontu, E.M. Carstea, I.-C. Ioja, L.I. Florescu, A.C. Dumitrache, G. Vanau, A.-M. Popa M. Moldoveanu, Land use impact on the levels of fluorescent dissolved organic matter, phytoplankton and zooplankton in urban lakes, Limnologica, 99, 126062 (2023) C.L. Popa, S.I. Dontu, E.A. Levei, C.I. Ioja, A.-M. Popa, M. Miclean, M.-A. Hoaghia, O. Cadar, E. M. Carstea, Spatial variation of organochlorine pesticides and dissolved organic matter in urban closed lakes, Journal of Environmental Science and Health, Part B, 5(4), 329-341 (2020)

Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://eertis.eu/errf-2300-000s-2713 Email: elfrida.carstea@inoe.ro

EX SITU AND *IN SITU* MONITORING OF AQUATIC SYSTEMS

Type of the service	Scientific service
Targeted areas	• Ecosystem health • Water pollution • Anthropogenic impact



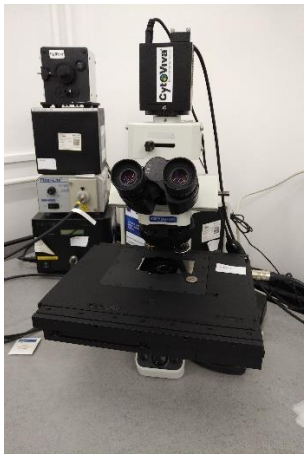
Short description	INOE has one of the best equipped laboratories used for the research of aquatic ecosystem quality, the MOCA laboratory, which is part of the Research Infrastructure Roadmap since 2021, aiming to study the anthropogenic impact on the quality of aquatic ecosystems. To this end, modern spectroscopic techniques and state-o-the-art infrastructure are being used, capable of providing fast and accurate information on the degree of pollutant contamination of aquatic systems. Thus, the core concept is to offer qualitative and quantitative information on the quality of aquatic systems using fluorescence spectroscopy, as well as chromatography and microbiology techniques. MOCA possesses a unique combination of high end instruments for the characterization of aquatic compounds, such as dissolved organic matter, polyaromatic hydrocarbons, or natural and artificial nanoparticles. The service includes *in situ* and *ex situ* tests as well as the interpretation of the obtained experimental results for the monitoring campaign of the chosen aquatic ecosystems.
Type of access	Physical
Access to service	The *in situ* monitoring of the physical parameters, as well as the sample collection procedure, necessary for the *ex situ* measurements, are carried out by INOE experts who accompany and operate the specific equipment, at the demander's location. For this type of measurements and procedures, the demander must provide the logistic necessary for the placement of all the portable sensors and to ensure the access for the experts on field in order to have a smooth operation of sample collection and preservation (details to be determined after the request is submitted). INOE ensures

	the smooth operation of the MOCA laboratory, at the institution headquarters, and provides all the necessary materials and supplies to perform all the laboratory tests. Office space can be made available for presentation of the obtained results interpreted and analyzed and for further discussions.
Technical details	**Laboratories and equipment involved** The equipment used for the characterization of aquatic systems and the nanoparticles detected within are part of the laboratory for optospectral methods for water quality assessment (MOCA), which is part of the Department of Constructive and Technological Engineering, Lasers & Fiber Optics Communications (https://eertis.eu/errf-2300-000s-2713). For the **tests performed *in situ***, the service dictates the use of the SMF4 portable fluorimeter, as well as the following portable sensors: Multiparametric probe, UviLux BOD, UviLux Tryptophan, the HI 255 Hanna Instruments multiparametric sensor and the Macherey-Nagel PF-12Plus photometer. With regard to **the tests performed in the laboratory** after the samples are collected by the INOE experts, the service mandates the use of Edinburgh Instruments FLS 920, Jasco FP8200 and Aqualog UV-800 spectrofluorimeters, Malvern Zetasizer Nano ZS900 instrument, BD Accuri C6 Plus flow cytometer, Thermo Scientific NanoDrop OneC Microvolume UV-Vis spectrophotometer and the Jasco HPLC LC4000 high-performance liquid chromatograph. **Applicable standard methods and procedures** To carry out the tests and experiments for the *in situ* and *ex situ* monitoring of the aquatic ecosystems mentioned in the request, the standard procedures used and recognized within INOE for the MOCA laboratory for the characterization of aquatic environments are applied. Upon the completion of tests and experiments, the obtained results are interpreted and an extensive report is drawn up full with all the explanation needed and the observations and recommendations of the INOE experts. **Representative parameters and accuracy** The SMF4 portable fluorimeter is used for the quantification of tryptophan, which is important for the determination of biochemical oxygen demand. Outputs: rapid identification of pollution caused by the presence of faecal matter in the aquatic systems. The portable sensors – EXO2 multiparametric probe, HI 255 Hanna Instruments multiparametric sensor, UviLux BOD and UviLux Tryptophan are used to determine physical parameters such as pH, conductivity, turbidity, dissolved oxygen, total algae, protein matter, humic substances and total dissolved solids. Outputs: quantitative and qualitative data on the physical parameters that characterize the state of the aquatic systems. Edinburgh Instruments FLS 920, Jasco FP8200 and Aqualog UV-800 spectrofluorimeters are used to characterize natural organic matter and organic pollutants. Outputs: excitation-emission matrices used to identify and characterize the presence of different types of pollutants from the aquatic systems. The Malvern Zetasizer Nano ZS900 instrument determines the hydrodynamic diameter of particles present in water samples and measures the zeta potential, the BD Accuri C6 Plus flow cytometer is used for live/dead cell detection, the Thermo Scientific NanoDrop OneC Microvolume UV-Vis spectrophotometer provides the necessary absorption spectra to identify the presence of dissolved organic matter in the evaluated water samples, the Jasco HPLC LC4000 high-performance liquid chromatograph is used to determine organic matter, polycyclic aromatic hydrocarbons

	or amino acids, and the Macherey-Nagel photometer PF-12Plus measures total organic carbon, phosphates, nitrates, chlorine and iron concentrations. Outputs: qualitative and quantitative data on the quality of water samples taken at a certain point in time, a temporal analysis representing the monitoring of the studied aquatic ecosystem.
Deliverables	Extensive report on water quality upon the monitoring campaign of the specified aquatic ecosystem, using *in situ* and *ex situ* tests and measurements, along with recommendations from our experts regarding the degree of water pollution.
References	• E.M. Carstea, C.L. Popa, A Baker, J Bridgeman, In situ fluorescence measurements of dissolved organic matter: a review, Science of the Total Environment, 699, 134361 (2020) • C. L. Popa, P. Bretcan, C. Radulescu, E.M. Carstea, D. Tanislav, S.I. Dontu, Spatial distribution of groundwater quality in connection with the surrounding land use and anthropogenic activity in rural areas, Acta Montanistica Slovaca, 24(2), 73-87 (2019) C.L. Popa, S.I. Dontu, E.M. Carstea, I.-C. Ioja, L.I. Florescu, A.C. Dumitrache, G. Vanau, A.-M. Popa M. Moldoveanu, Land use impact on the levels of fluorescent dissolved organic matter, phytoplankton and zooplankton in urban lakes, Limnologica, 99, 126062 (2023)
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://eertis.eu/errf-2300-000s-2713 Email: elfrida.carstea@inoe.ro

CHARACTERIZATION OF THE PARTICLES PRESENT IN THE AQUATIC ENVIRONMENT

Type of the service	Scientific service
Targeted areas	• Ecosystem health • Water pollution • Anthropogenic impact



Short description	INOE has one of the best equipped laboratories used for the research of aquatic ecosystem quality, the MOCA laboratory, which is part of the Research Infrastructure Roadmap since 2021, aiming to study the anthropogenic impact on the quality of aquatic ecosystems. To this end, modern spectroscopic techniques and state-o-the-art infrastructure are being used, capable of providing fast and accurate information on the degree of pollutant contamination of aquatic systems. Thus, the core concept is to offer qualitative and quantitative information on the quality of aquatic systems using fluorescence spectroscopy, as well as chromatography and microbiology techniques. MOCA possesses a unique combination of high end instruments for the characterization of aquatic compounds, such as dissolved organic matter, polyaromatic hydrocarbons, or natural and artificial nanoparticles. The service includes ultra-performant tests made in our laboratory for the evaluation and characterization of nanoparticles present in aquatic ecosystems.
Type of access	Physical
Access to service	Sample collection necessary for the detailed studies performed in the laboratory is carried out by INOE experts who accompany and operate the specific equipment, at the demander's location. The demander must provide the logistics necessary for the sample collection and must ensure the access of INOE experts for the smooth operation of sample collection and preservation (details to be determined after the request is submitted).

Technical details	**Laboratories and equipment involved** The equipment used for the characterization of aquatic systems and the nanoparticles detected within are part of the laboratory for optospectral methods for water quality assessment (MOCA), which is part of the Department of Constructive and Technological Engineering, Lasers & Fiber Optics Communications (https://eertis.eu/errf-2300-000s-2713). For the tests made in the laboratory after the sample collection operation performed by the INOE experts, the service dictates the use of a FFF Wyatt AF4 Fractionation System, of Malvern NanoSight NS300 and Malvern Zetasizer Nano ZS900 instruments, a Cytoviva Enhanced Dark Field Hyperspectral Microscope and of a BD Accuri C6 Plus flow cytometer. **Applicable standard methods and procedures** To carry out the tests and experiments aimed at characterizing the nanoparticles present in the aquatic ecosystems mentioned in the request, the standard procedures used and recognized within INOE for the MOCA laboratory for the characterization of aquatic environments are applied. Upon the completion of tests and experiments, the obtained results are interpreted and an extensive report is drawn up full with all the explanation needed and the observations and recommendations of the INOE experts. **Representative parameters and accuracy** The FFF Wyatt AF4 Fractionation System is used for the characterization of particles in suspension with sizes between 10 and 1000 nm – liposomes, latex particles, colloidal suspensions, proteins and aggregates. Outputs: data on the size distribution of nanoparticles present in the analyzed water samples. The Malvern NanoSight NS300 and Malvern Zetasizer Nano ZS900 instruments allow the real-time visualization of the particles present in the water samples and the determination of particle concentration for particles with sizes between 10 and 2000 nm, as well as the hydrodynamic size of the particles and zeta potential. Outputs: data on the sizes and specific characteristics of the nanoparticles identified in the analyzed water samples. The Cytoviva Enhanced Dark Field Hyperspectral Microscope enables the visualization and characterization of particles with sizes down to 2 nm and the BD Accusi C6 Plus flow cytometer is used for the detection and quantification of live/dead cells. Outputs: hyperspectral images of identified nanoparticles and data on the ration between live and dead cells present in the analyzed samples.
Deliverables	Extensive report on the contamination status of the aquatic ecosystems, as well as the characterization of the particles detected and identified in the analyzed water samples.
References	• T. Cecchi, D. Poletton, A.C. Berbecaru, E.M. Carstea, M. Rapa, Assessing microplastics and nanoparticles in the surface seawater of Venica Lagoon – Part I: Methodology of research, Materials, 17, 1759(1-20 (2024) • S. Dontu, C. L. Popa, E. M. Carstea, D. Tenciu, Optoelectronic investigation for determination of plastics polymers behavior in surface water, Journal of Optoelectroics and Advanced Materials, 23(11-12), 624-629 (2021) C.L. Popa, S.I. Dontu, E.M. Carstea, E. A. Levei, C. Ioja, A. M. Popa, M. Miclean, O. Cadar, Organochlorine pesticides and dissolved organic matter within a system of urban exorheic lakes, Environmental Monitoring and Assessment, 192(1), 59 (2019)

Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://eertis.eu/errf-2300-000s-2713 Email: elfrida.carstea@inoe.ro

ASSESSMENT OF SOIL MICROBIODIVERSITY AND FUNCTIONS

Type of the service	Scientific service
Targeted areas	• Soil science • Biodiversity • Ecosystem services

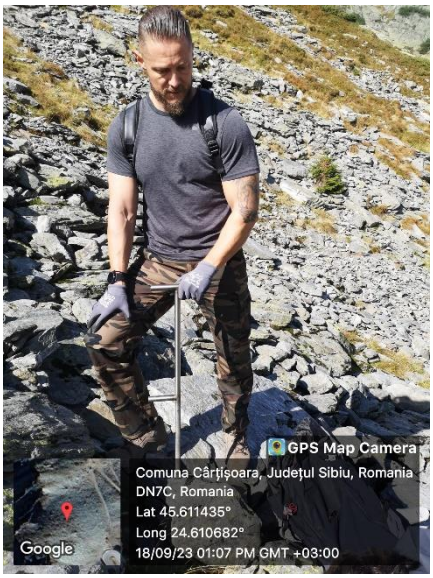
Short description	The BIODIVERSA laboratory of INCDO INOE, ICIA Subsidiary, assesses soil microbiodiversity and functions with the aim of generating know-how that can be used to develop strategies to conserve soil microbiodiversity and maintain the ecosystem functions and services it supports. The BIODIVERSA laboratory conducts research that describes for the first time the complex ecological functional relationships mediated by the soil microbiota. The information generated in the BIODIVERSA laboratory is intended for decision-makers in the Ministry of Environment, Water and Forests; the National Agency for Environmental Protection; Municipal Planning and Control Services; Non-Governmental Organisations for Environmental Protection and Biodiversity Conservation; etc.
Type of access	Hybrid
Access to service	The BIODIVERSA laboratory carries out activities to assess microbiodiversity and soil functions both in the field and in the laboratory. The BIODIVERSA laboratory exploits the identified interactive relationships to contribute to the formulation of best practice guidelines for the conservation of soil biodiversity and the maintenance of soil ecosystem functions and services. Access is physical for discussions between the beneficiary and the research team based on the results of the evaluation studies. The research team provides support for both the development of remediation strategies and the subsequent effective evaluation of the effectiveness of the implemented strategies.

Technical details	**Laboratories and equipment involved** BIODIVERSA laboratory (https://eeris.eu/ERIF-2000-000L-1019) consist of: ♦ complex mass spectrometric and chromatographic systems (GC-MS/MS, GC-FID, GC-ECD) that allow: soil microbiome phenotypic structure and metabolic and volatilomic profile assessment; ♦ complex sequencing system (MALDI-TOF/TOM MS IMS) that allow multiple "omics" analysis in soil (proteomics, lipidomics, metabolomics, etc.); ♦ complex spectroscopic system that allow biochemical reactions establishment and quantitative description (MicroPlate-Reader); ♦ complex microscopic systems that allow soil microbiome physiological characterizations (Inverted Epi=Fluorescence Mycroscope); ♦ complex climate chamber that allow to simulate global change drivers impact on soil microbiome with aim to formulate mitigation solutions at current and future challenges. **Applicable standard methods and procedures** BIODIVERSA laboratory contribute to development of new analytical and numerical approaches that allow microbiome assessment; soil functions evaluation; and services prediction. **Representative parameters and accuracy** The complex mass spectrometric and chromatographic systems GC-MS/MS, GC-FID, GC-ECD) allow soil microbiome phenotypic structure quantification at nmol level and formulate the metabolic profile of components between 50 - 1000 m/z molecular fractions. The complex sequencing system (MALDI-TOF/TOM MS IMS) allow identification and annotation of molecules till 500 kDA. The complex spectroscopic system for biochemical reactions establishment and quantitation allows multimode analysis in absorbance, fluorescence and luminescence. The complex microscopic systems permit fluorescence and visible assessment of soil microorganism physiological pattern. The complex climate chamber has a 1 m^3 capacity for controlled conditions.
Deliverables	Experimental reports that describe soil microbiodiversity, functions and services.
References	The potential of the BIODIVERSA laboratory has been harnessed by: **♦ winning several projects in competition** (PNRR, PN-III-MC, etc.). These projects have allowed both the expansion of scientific capabilities and their testing with research teams from the following universities and academies: Sun-Yat Sen University (Guangzhou, China), Capital Normal University (Beijing, China), Nagoya University (Nagoya, Japan); Tsukuba Research Centre (Tsukuba, Japan); Polish Academy of Sciences (Poznan, Polland); etc. **♦ publication of the results as a book chapter in international publishing houses:** Global Change Drivers Impact on Soil Microbiota: Challenges for Maintaining Soil Ecosystem Services? Kovacs ED., Kovacs MH. In. Vegetation Dynamics, Changing Ecosystems and Human Responsibility, Edited by Levente Hufnagel and Mohamed A. El-Esawi, Croatia, InTech., **2023**. https://doi.org/10.5772/intechopen.111585 **♦ publication of results in scientific journals:** Structural and metabolic profiling of Lycopersicon esculetum rhizosphere microbiota artificially exposed at commonly used non-steroidal anti-inflammatory drugs. Kovacs ED., Silaghi-Dumitrescu L., Roman C., Tian D. Microorganisms, **2022**, 10:254 (IF: 4.926) https://doi.org/10.3390/microorganisms10020254

	Determination of the uptake of ibuprofen, ketoprofen and diclofenac by tomatoes, radishes and lettuce by Gas Chromatography-Mass Spectrometry (GC-MS). Kovacs ED., Silaghi-Dumitrescu L., Kovacs MH., Roman C., Analytical Letters, **2021**, 54:1, (IF: 2.267) https://doi.org/10.1080/00032719.2020.1779278 Family-level leaf nitrogen and phosphorus stoichiometry of global terrestrial plants. Tian D., Yan Z., Ma S., Ding Y., Luo Y., Chen Y., Du E., Han W., Kovacs ED., Shen H., Hu H., Kattge J., Schmid B., Fang J. Science China Life Sciences, **2019**, 62(8):1047-1057 (IF: 4.611) https://doi.org/10.1007/s11427-019-9584-1 **♦ obtaining patents:** Rapid methods for determination of organometallic compounds in soil samples by ultrasonic-headspace-microextraction in solid phase and gas chromatography coupled with mass spectrometry (USE-HS-SPME-GC-MS), Kovacs MH., Kovacs ED., Roman C., Miclean M., Hotararea No. 3/57, 29.05.2020, OSIM (**2020**)
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.icia.ro Email: melinda.kovacs@icia.ro

ASSESSMENT OF ENVIRONMENTAL FACTORS QUALITY – ENVIRONMENTAL ANALYSIS LABORATORY (LAM)

Type of the service	Technological service
Targeted areas	• Assessment of environmental factors quality (water, air, soil, and food) • Assessment of fuels and biofuels quality • Determination of natural and synthetic materials composition and assessment of their quality



Short description	The environmental analysis laboratory (LAM) offers services for evaluating the quality of environmental factors (water, air, soil, and food), fuels and biofuels, and natural and synthetic materials. The laboratory is accredited by the Romanian Accreditation Association RENAR according to ISO 17025:2018 (certificate no. LI 1778/25.05.2018) and authorized by the National Veterinary Sanitary and Food Safety Authority ANSVSA (no. 125/15.07.2016). The services offered by the laboratory are addressed to corporate clients who need physicochemical analyses according to the environmental authorization, who want to verify and adjust the operating parameters of some installations, who want to evaluate a product obtained in the production process, and to individual clients. The laboratory also offers on-demand method development services according to national and/or international standards and provides consultancy on meeting environmental requirements to its customers.
Type of access	Physical
Access to service	The services provided by LAM, physico-chemical analyses in the laboratory and on-site, can be accessed based on an order or a collaboration contract after establishing the collaboration conditions. The samples to be analyzed can be sent to the laboratory by the beneficiary or taken by the authorized personnel of the laboratory. The samples are checked and coded before entering the laboratory to ensure the data's

	confidentiality and the laboratory staff's impartiality and then further analyzed. The client, company, or individual, can assist in the execution of the analyses after submitting a request in this regard.
Technical details	**Laboratories and equipment involved** The Environmental Analysis Laboratory, LAM, is a department within the ICIA Cluj-Napoca Subsidiary. The laboratory has rooms that comply with the environmental requirements necessary to carry out analyses according to the standards in force and metrologically calibrated equipment both for carrying out gravimetric, volumetric, and electrophysical analyses, as well as for ultra-trace analyses of contaminants from environmental samples, fuels, and biofuels and materials or to characterize naturally occurring compounds in these samples. Among these, we mention: Mass spectrometer with inductively coupled plasma (https://eertis.eu/ereq-2300-008g-8311); Gas chromatograph with ECD detector (https://eertis.eu/ereq-2300-008z-8329); Gas chromatograph with FID detector (https://eertis.eu/ereq-2300-008l-8332); Liquid chromatograph with UV and FLD detectors (https://eertis.eu/ereq-2300-008v-8308); Uv-VIS spectrophotometer (https://eertis.eu/ereq-2300-008m-8323). **Applicable standard methods and procedures** The physico-chemical analyzes performed in LAM are based on national and international standards in force. These standards are mentioned in the appendices of the ISO 17025:2018 accreditation certificate issued by RENAR and are available on the laboratory's website www.analizechimice.ro **Representative parameters and accuracy** The representative parameters and the accuracy of the determination methods are established according to the applied standards and the legislation in force.
Deliverables	Test reports containing the results of the physico-chemical analyses to which the test samples were subjected and the reporting of the results to the applicable legislation.
References	The laboratory has confidentiality clauses with its clients. Among the clients of the laboratory that allow their public mention are: Compania de Apa Someș; Farmec S.A.; CFR Călători and CFR Marfă Cluj; Astra Rail Arad; AOT Energy Arad; OCON Ecorisc Turda; Naposint Răscruci.
Terms of execution	The deadline for the requested works is max. 15 working days from the registration of the sample to be analyzed. Partial reproduction of the Test Report is prohibited without the approval of the laboratory.
Contact	Website: www.analizechimice.ro Email: lam@icia.ro

SOLUTIONS FOR DECONTAMINATION AND ENVIRONMENTAL MONITORING

Type of the service	Scientific service
Targeted areas	• Monitoring air, water, and soil quality • Health risk assessment and calculation of pollution indices • Development of solutions for environmental decontamination and monitoring of decontamination processes

ICP-QQQ-MS

Mobile laboratory

Short description	Within INOE, ICIA Subsidiary operates the Environment and Health Laboratory, with the main objective being the development of environmental technologies designed to prevent pollution; environmental decontamination and the development of methods for assessing and monitoring environmental factors (soil, water, air). It includes the Laboratory "Environmental Factors" whose service is dedicated to the elaboration and development of processes aiming at the assessment of environmental quality and the development of decontamination technologies. The laboratory service also includes health risk assessment and calculation of pollution indices; thus, a full range of environmental solutions are offered: identification of problems, proposal of technical solutions to solve them and monitoring of decontamination processes. The service is provided to enterprises carrying out environmental decontamination activities as well as to local or government authorities.
Type of access	Physical
Access to service	The service of developing innovative processes dedicated to the development of environmental remediation and environmental quality monitoring technologies can be carried out both by ICIA personnel for interested clients, and through research activities carried out in effective collaboration with client specialists, followed by the transfer of results to the beneficiary. If the service is carried out by ICIA personnel, clients may assist in the execution of the work, in compliance with labour protection regulations. In the case of the transfer of results for implementation to the client, ICIA' staff can help in implementing the results at the client. Office space can be provided for the analysis

	of results and discussions. Details of access to the infrastructure are determined after the client has submitted a service request.
Technical details	**Laboratories and equipment involved** The Laboratory "Environmental Factors" is part of the Research & Development Department of the ICIA Subsidiary, located in Cluj-Napoca, 67 Donath Street. It has all the necessary infrastructure to provide the service. To view the infrastructure, please visit the link https://eertis.eu/erso-2300-000r-3117 where details of the equipment available are given. The main equipment that can be used to provide the service are: Mobile auto lab for air quality determination; Inductively Coupled Plasma Triplex Mass Spectrometer ICP-QQQ-MS (ThermoFisher); X-ray Diffractometer (XRD - Bruker); SEM microscope (Tescan), Gas chromatograph coupled with triple quadrupole mass spectrometer (GC-MS/MS, Thermo Scientific), X-ray fluorescence spectrometer, XRF (Bruker), Inductively coupled plasma optical emission spectrometer, ICP-OES (Perkin Elmer). **Applicable standard methods and procedures** ICP-QQQ-MS spectrometer - multi-element determination of over 70 elements at ultra-trace level; XRD – identification and quantification of crystalline phases of powder samples; SEM - structural characterisation of solid samples; GC-MS-MS - determination of organic contaminants in water, air, soil; XRF - elemental composition analysis of solid samples; ICP-OES - multi-element determination of over 50 elements at trace level. **Representative parameters and accuracy** Environmental decontamination solutions - technologies for the remediation of environmental factors: decontamination of soils polluted with heavy metals or organic substances; decontamination of industrial waters polluted with heavy metals, ammonium, nitrites, nitrates, dyes, organic substances; air purification, using filters with adsorbent material.
Deliverables	Modern analytical methods developed for environmental quality characterization; Environmental factor quality monitoring report; Report on health risk assessment and pollution index calculation; Remediation technologies of environmental factors
References	Innovative technology for the remediation of hydrocarbon contaminated soils; Innovative technology for the remediation of contaminated soils by specific activities of the metallurgical industry; Adsorbent material based on zeolitic material for the retention of ammonium and hydrogen sulphide from contaminated media; Adsorbent material based on zeolitic material for the adsorption of hydrocarbons from contaminated media; Zeolite-based filter material for heavy metals and radioactive substances; Activated zeolite material for soil decontamination; Automated zeolite-based filter plant for industrial water treatment plants; Zeolite-based filter plants with internet and mobile phone monitoring and control of filtration processes (www.icia.ro)
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.https://icia.ro/ Email: marin.senila@icia.ro

SOLUTIONS FOR ENSURING FOOD SAFETY AND SECURITY

Type of the service	Scientific service
Targeted areas	• Development of innovative analytical methods for assessing the safety and security of agricultural and food production • Implementation of advanced solutions in food technology • Development of technical and analytical solutions to ensure food security in the face of challenges such as climate change, global trade and economic crises

Short description	The service combines contaminant analysis and nutritional value assessment with the development of innovative technologies for the extraction and use of alternative proteins and plant food supplements. We use techniques such as mass spectrometry and chromatography to detect contaminants and nutritionally assess foods. We also develop processes for extracting bioactive compounds from plant sources and formulating new dietary supplements and functional foods. Our service integrates advanced technologies for the development of sustainable and nutritious food products, offering customized solutions for the extraction of alternative proteins and plant extracts. It is relevant to the food industry, functional food manufacturers and research organizations interested in healthy and sustainable food innovation.
Type of access	Hybrid
Access to service	Access to the service of analysis of contaminants and development of technologies for alternative proteins and food supplements can be carried out both at the headquarters of INCDO-INOE ICIA Cluj-Napoca and at the customer's location. Access is physical, where the customer can participate and operate alongside our team on the analysis and processing equipment, or alternatively, our experts can carry out activities at the customer's premises with the necessary portable equipment. INCDO-INOE ICIA Cluj-Napoca has specially equipped laboratories for advanced analysis and new product development, including dedicated spaces for biotechnologies and microencapsulation, all equipped with power supply, temperature control systems and internet connection.

	Conference rooms and offices can be made available for discussion and analysis of results.
Technical details	**Laboratories and equipment involved** The laboratories involved in this service include the Laboratory for the detection of traces of GMOs and food safety, MODALIM, for the elaboration and development of innovative processes for the determination of genetically modified organisms (GMOs), the quality of food and functional foods, and the Laboratory for the control of chemical residues food, REZALIM for the elaboration and development of innovative processes for the determination of the chemical substance. compounds naturally present in food, pollutants (PAHs, pesticides) and additives (preservatives, synthetic colors and sweeteners). Key equipment used includes high performance liquid chromatography (HPLC) coupled to mass spectrometry, atomic absorption spectrometers for heavy metal analysis and supercritical fluid extraction systems for plant extracts. More details about laboratories and equipment can be found on the EERIS page: https://eertis.eu/erso-2300-000r-3117. **Applicable standard methods and procedures** The methods used in this service include standardized analytical techniques according to international regulations, such as ISO methods for the determination of contaminants and nutritional analysis. Procedures include liquid and gas chromatography, mass spectrometry, and methods to improve the stability and bioavailability of nutritional compounds. These methods ensure an accurate and detailed assessment of food composition and safety. **Representative parameters and accuracy** The main features of this service include the accurate determination of contaminant levels such as heavy metals, mycotoxins and pesticide residues with an accuracy that complies with international standards. The service also provides detailed assessments of nutritional profiles, including vitamins, minerals and bioactive compounds. The accuracy and reliability of the results are ensured by the use of state-of-the-art equipment and validated procedures in our laboratories, including those in the REZALIM and MODALIM laboratories.
Deliverables	• Detailed analysis reports; • Bioavailability and stability results; • Complementary analyses; • Technical recommendations for optimization; • Technical documentation: new technologies and recipes.
References	1. Muntean, G.-C.; Simedru, D.; Uiuiu, P.; Tanaselia, C.; Cadar, O.; Becze, A.; Coroian, A. Evaluation of Alternative Sources of Proteins and Other Nutrients with Potential Applications in Fish Nutrition. Molecules 2024, 29, 2332. https://doi.org/10.3390/molecules2910233 2. Topan, C.; Nicolescu, M.; Simedru, D.; Becze, A. Complex Evaluation of Storage Impact on Maize (Zea mays L.) Quality Using Chromatographic Methods. Separations 2023, 10, 412. https://doi.org/10.3390/separations10070412 3. Dordai, L.; Simedru, D.; Cadar, O.; Becze, A. Simulated Gastrointestinal Digestion of Nutritive Raw Bars: Assessment of Nutrient Bioavailability. Foods 2023, 12, 2300. https://doi.org/10.3390/foods12122300

	4. Simedru, D.; Becze, A. Complex Profiling of Roasted Coffee Based on Origin and Production Scale. Agriculture 2023, 13, 1146. https://doi.org/10.3390/agriculture13061146 5. Patent for washing root, bulbous or tuberous vegetables, A201800672.
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.icia.ro Email: anca.becze@icia.ro

DESIGN AND IMPLEMENTATION OF GREEN TECHNOLOGIES FOR BIOFUEL PRODUCTION

Type of the service	Scientific service
Targeted areas	• Bioenergy - biomass • Circular bioeconomy • Clean technologies for biofuel production

Reactor for biogas production

Pellets produced form vine shoot **waste**

Short description	INOE-ICIA has a Bioenergy-Biomass Laboratory (Renewable Energy Laboratory, LER, and Biofuel Quality Certification Laboratory, CABIO) dedicated to the development and implementation of green technologies for biofuel production and efficient biomass conversion. INOE-ICIA offers/develops green technologies for the production of liquid, solid and gaseous biofuels, biomass conversion processes, as well as testing and analysis of the resulting biofuels. The service ensures the design and implementation of green technologies for the production of renewable biofuels, efficient biomass conversion technologies, and biofuel quality certification in accordance with current standards. INOE-ICIA has the equipment and installations for developing innovative solutions from design to pilot level. ICIA can ensure the commissioning of biodiesel production plants.
Type of access	Physical
Access to service	The services are provided at the INOE-ICIA headquarters. Services offered include: (1) Designing green technologies for biofuel production (liquid, solid, and gaseous) based on technical feasibility (type of raw material, processing technologies, and scalability) and economic feasibility (cost-benefit analysis), (2) Process design (technology selection, identification, and selection of the most suitable technologies, process optimization), (3) Testing, validating, and optimizing biofuel production technologies to achieve optimal efficiency and yield, (4) Biofuel analysis and certification, and (5) Sustainability and durability evaluation through life cycle analysis (LCA) and carbon footprint assessment (details are established after the request is submitted).

Technical details	**Laboratories and equipment involved** ICIA possesses a variety of equipment and facilities for the development/testing and validation of biofuel production technologies, equipment's used for biomass analysis, biochemical conversion of biomass (fermentation, enzymatic hydrolysis, anaerobic digestion, pelletization, and briquetting), as well as equipment for biofuel analysis. The available equipment can be accessed at https://eertis.eu/erso-2300-000r-3117 and includes the following items: (1) Plants and equipment for biomass conversion processes: pretreatment reactor (Parr bioreactor), bioreactors for fermentation (Lambda Minifor), biofermenter for biogas production (Automated Methane Production Potential Test System (AMPTS), reactor for continuous biogas production (Gas Endeavor III); (2) Analytical equipment for biomass and biofuel analysis includes a gas chromatograph coupled with different types of detectors, such as a mass detector (GC-MS), an electron capture detector (GC-ECD), and a flame ionisation detector (GC-FID). Additionally, the laboratory possesses an ion chromatograph, a liquid chromatograph (UHPLC-ELSD, DAD, RI), and other similar instruments. **Applicable standard methods and procedures** Technology design is based on preliminary biomass analysis and the desired type of biofuel. Testing and certification of biofuels comply with SR EN 14214 standards for biodiesel and SR EN 15376 for bioethanol. Biofuel performance evaluations are carried out through various combustion tests (combustion gas analysis). Environmental and sustainability assessments are ensured through life cycle analysis, which includes evaluating the environmental impact of technology and biofuel use. The LCA methodology complies with the ISO 14040 standard. **Representative parameters and accuracy** The design of green technologies involves essential parameters and ensuring high accuracy to obtain efficient, sustainable, and economical processes. Representative parameters include: raw material selection and treatment parameters (chemical composition), biochemical conversion, process integration, experimental validation, process control, and monitoring, etc.
Deliverables	Green biofuel production technology project. Test report on biofuel testing. Commissioning report for biofuel production installations.
References	Green technologies have been implemented in various research projects: green technologies for bioethanol, biodiesel, and biogas production, obtaining pellets and briquettes from vine cuttings; green bioethanol production technologies from lignocellulosic biomass; green biogas production technology from lignocellulosic and/or biogenic biomass. (https://icia.ro/).
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://icia.ro/ E-mail: lacri.senila@icia.ro

OPTOELECTRONIC EQUIPMENT AND MECHATRONICS

TESTING AND CALIBRATION OF AEROSOL LIDAR SYSTEMS

Type of the service	Technological service
Targeted areas	• Atmospheric research • Design and implementation of lidar systems for aerosol detection • Warning systems for high altitude particle intrusions

Short description	INOE operates the "Lidar Calibration Center" unit within the Aerosol Remote Sensing Center. This is a central facility of the pan-European research infrastructure ACTRIS, which is responsible for the assurance and quality control of data collected at national aerosol remote sensing facilities. Lidar system calibration services are organized within this unit by direct comparison with reference lidar systems. The service includes the intercomparison experiment as well as the realization of specific tests for the identification of biases and the quantification of correction factors.
Type of access	Physical
Access to service	Calibration by direct comparison of aerosol lidar systems with reference lidar systems can be performed at INOE headquarters or at the user's location. Access is physical (the user accompanies and operates his own system at the INOE headquarters / INOE experts accompany and operate the lidar reference system at the user's location). INOE has the necessary outdoor space for the location of the lidar system to be tested, which is equipped with electricity, perimeter lighting and internet connection. Office space can be made available for analysis of results and discussions. If the service is requested at the user's location, it must provide the necessary logistics for the location of the reference lidar system and the performance of the experts' work (details to be determined after the request is submitted).

Technical details	**Laboratories and equipment involved** The two reference lidar systems are part of the aerosol remote sensing laboratory within INOE's Remote Sensing department (https://eertis.eu/errf-2300-000u-1746). The ALPHA reference lidar system is a multi-wavelength, multi-depolarization, Raman and high spectral resolution system with continuous operation. This is used when very high accuracy is required or when the system to be tested has channels in the ALPHA wavelength spectrum. The MILI reference lidar system is an ultraviolet scanning system that can also be used in locations where there is a risk of exposure. **Applicable standard methods and procedures** For calibration by direct comparison of aerosol lidar systems with reference lidar systems simultaneous observations are performed, ACTRIS standard procedures and tests are applied (https://www.actris.eu/sites/default/files/inline-files/QAPs- CARS-Jan2024-v01-rev12.pdf), results are analyzed and recommendations for improvement are made. **Representative parameters and accuracy** The ALPHA reference lidar system has a dynamic range of 0.3-20 km, depending on the atmospheric transmission, with a spatial resolution of 3.75 m. Outputs: backscatter coefficients at 1064, 532 and 355 nm, coefficients of extinction by Raman detection at 1064, 532, and 355 nm, extinction coefficient at 532 nm by high spectral resolution detection, and linear particle depolarization ratio s at 1064, 532, and 355 nm. The MILI reference system has a UV laser emission wavelength of 355 nm and a dynamic range of 1-15 km, depending on atmospheric transmission, with a spatial resolution of 7.5 m. Outputs: backscatter coefficient at 355 nm and the linear particle depolarization ratio at 355 nm in each scan direction.
Deliverables	Report on aerosol lidar system testing
References	The lidar system testing procedures were applied to the lidar system of the University "Babes-Bolyai" Cluj-Napoca, to the lidar system of the ACTRIS national facility operated by INOE and to the lidar system of the European Space Agency operated by the University of Warsaw. Similar services are in progress for the European Space Agency's lidar system operated by the National Observatory in Athens and for the prototype lidar system developed by Raymetrics
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://www.actris.eu/topical-centre/cars E-mail: livio@inoe.ro

ANALYSIS OF THE DEGREE OF CONTAMINATION OF THE WORKING FLUID

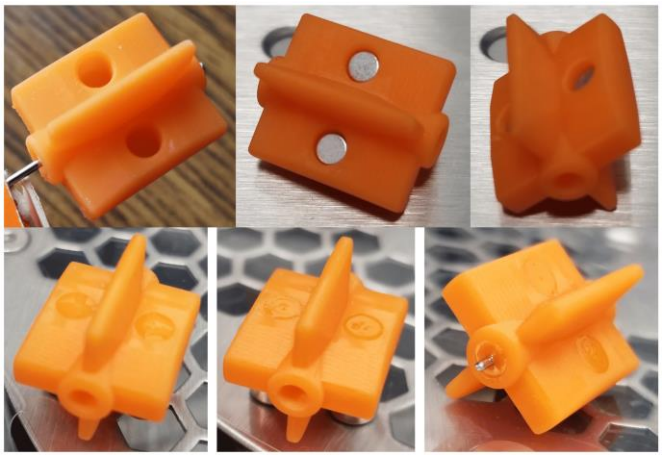
Type of the service	Technological service
Targeted areas	• Tribological research • Maintenance of industrial or mobile hydraulic drive systems

Short description	INOE 2000 - IHP Subsidiary offers testing services for the quality of the working fluid specific to hydraulic drives (mineral oil and petroleum-based fluids) within the *Fluid Mechanics Laboratory* of the *General Hydraulics Department* by using the Laser CM 20 device. The device monitors the degree of contamination of the fluid with impurities of different sizes, to decide whether or not to use the oil. The oil analysis is done by counting the impurities in the tested sample and identifying the sizes of the impurities which will then be compared with values from international standards.
Type of access	Physical
Access to service	The analysis of the contamination of the working fluid can be carried out at the institute's premises or at the location of the beneficiary/consumer, based on a contract or an order note. The oil sample is taken in 100 ml containers and brought for testing in the laboratory or in the space allocated by the beneficiary for testing. A specialist of IHP prepares the device by an initial flushing of the circuits, and the oil sample is subjected to deaeration, after which the actual testing is carried out. The determination of the number and size of the contaminating particles is made after passing the oil in front of a laser beam.

Technical details	**Laboratories and equipment involved** The LCM 20 device used for hydraulic oil testing is part of the equipment of the *Fluid Mechanics Laboratory* of INOE 2000 - IHP Subsidiary (https://eertis.eu/erlb-2300-000n-7446). **Applicable standard methods and procedures** According to the user manual issued by the manufacturer Parker Hannifin, the device uses optical scanning to measure the particle size for testing, and the measurement result is printed in NAS or ISO code, or the data can be transmitted to a PC. The interpretation of the results is done in accordance with ISO 4406; NAS 1638; AS4059E; GOST 17216. **Representative parameters and accuracy** Test time: 2 minutes International codes used: ISO 7-22 and NAS 0-12 Automatic storage memory: 300 tests Viscosity: 100 cSt Connection: RS232 to USB computer interface Power supply: 12 V DC or 6 x 1.5 V alkaline batteries. Recalibration: Automatic reporting and possibility of Parker Certification
Deliverables	Printed test result
References	INOE 2000 IHP subsidiary carried out hydraulic oil testing for different beneficiaries in the industry, based on contracts or work orders (Hansa-Flex Romania Ltd., Visteon Project Ltd., Lyra Hydraulics Consulting Ltd., etc.)
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://ihp.ro/lab_mecanica_fluidelor.htm Email: office.ihp@fluidas.ro

ADDITIVE MANUFACTURING, 3D SCANNING AND 3D MODELING

Type of the service	Technological service
Targeted areas	• Prototyping and Rapid Manufacturing • Product Design and Development • Reverse Engineering and Quality Control



Short description	The services of additive manufacturing (3D printing), 3D scanning using structured light and 3D modeling, including structural topological optimization with finite element, are provided by the Laboratory of Advanced Engineering and Smart Technologies, which encompasses a comprehensive technological service range. Our services provide a cutting-edge solution for prototyping, product design, and reverse engineering across various industries. Our uniqueness lies in the integration of state-of-the-art equipment and expertise to deliver high-quality, customized solutions tailored to the specific needs of our clients. Whether it's rapid prototyping, intricate product design, or precise reverse engineering, our services cater to a wide range of applications, from automotive to aerospace and beyond.
Type of access	Hybrid
Access to service	Clients can access our services through both on-site and remote means. On-site access allows direct interaction with our equipment and experts, while remote access facilitates collaboration and submission of digital files for processing.

Technical details	**Laboratories and equipment involved**: The Laboratory of Advanced Engineering and Smart Technologies https://eertis.eu/erlb-2400-001q-0840 provided with the following equipment: • Prusa SL1S 3D printer (MSLA technology); • BCN3D Sigma R19 3D printer (FDM technology); • Dedicated ultrasonic bath for 3D printed parts washing; • Station for washing and post-processing for MSLA printing technology; • EinScan-SP 3D scanner and "EXScan S" software; • Workstation with SOLIDWORKS Professional software, including numerical simulation modules. **Applicable standard methods and procedures**: We adhere to industry-standard methods and procedures for additive manufacturing, 3D scanning, and 3D modeling, ensuring quality and reliability in our deliverables. Our processes comply with ISO standards for additive manufacturing. **Representative parameters and accuracy:** Our service offers high precision and accuracy, with parameters tailored to meet the specific requirements of each project. From layer resolution in additive manufacturing to point cloud density in 3D scanning, we ensure the utmost fidelity to the original design or object.
Deliverables	• 3D printed prototypes and parts; • High-resolution 3D scans and point clouds; • Detailed 3D models, including structural topological optimization with finite element.
References	Leveraging Additive Manufacturing and Reverse Engineering for Circular Economy-Driven Remanufacturing of Hydraulic Drive System Components - https://doi.org/10.3390/app132212200 Determining the Optimal Printing Conditions for the Production of a Fertigation Pump Prototype with FDM Technology - https://doi.org/10.37358/MP.21.2.5485
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://eertis.eu/erlb-2400-001q-0840 Email: chirita.ihp@fluidas.ro

DEVELOPMENT OF TEST BENCHES IN THE FIELD OF RENEWABLE ENERGY CONVERSION

Type of the service	Technological service
Targeted areas	• Design and development of benches for testing reduced-scale models of axial hydraulic turbines • Design and development of benches for testing low-head hydraulic turbines

Short description	INOE 2000 – IHP Subsidiary offers services for the design, construction and commissioning of benches for the experimental research of two categories of hydropower units: axial hydraulic turbines, with a vertical or axial shaft, and low-head hydraulic turbines. On the first category of benches, it is possible to experimentally determine, successively in two stages, both the speed distribution on the rotor blades of axial hydraulic turbines of small dimensions and masses, in order to optimize their hydrodynamic profile, in the first stage, as well as the mechanical parameters, speed and torque, of the hydraulic turbine rotors, with the previously experimentally optimized blade profile, in the second stage. On the second category of benches, in which water is circulated between two superimposed tanks, the flow rate and drop are maintained at constant values, necessary for the operation of the tested turbine, throughout the duration of the test.
Type of access	Physical
Access to service	The design and construction service can be requested at the headquarters of INOE 2000 - IHP Subsidiary in Bucharest, which has specialists and equipment necessary for the design, construction and commissioning of the two categories of benches. The service can be accessed on the basis of a bench design / construction theme, in which one will specify: test parameters of the turbine to be tested (head H, flow rate Q, load M); maximum sizes of the turbine model that will be tested on the bench; maximum overall sizes of the bench; level of automation of the bench (manual / automatic control, data acquisition, database and plotting characteristic curves). The commissioning service can also be requested at the beneficiary's premises, provided that all the necessary utilities (assembly space, water and energy supply, sewerage system) are provided.

Technical details	**Laboratories and equipment involved** The two types of benches can be developed within: General Hydraulics department, General Hydraulics laboratory https://eertis.eu/erlb-2300-000h-7457 and Fluid Mechanics laboratory https://eertis.eu/erlb-2300-000n-7446; Servo Techniques, Electronics and Mechatronics department, Electronic Equipment laboratory https://eertis.eu/erlb-2300-000v-7417; Special Equipment department, Environmental Protection laboratory https://eertis.eu/erlb-2300-000k-7496. **Applicable standard methods and procedures** The first category of benches ensures automatic flow rate control and a uniform flow speed in a transparent horizontal test pipe section. A SCADA system, three transducers and a PC computer perform the following: control of the adjustable braking system and pumping group flow regulation; monitoring and acquisition of adjustable bench parameters (flow rate and water speed) in the test pipe section and of mechanical parameters of the adjustable braking system (torque and rotational speed). The second category ensures that the head is maintained constant by a closed-loop regulation of the flow rate. To determine the energy parameters of the turbine, its shaft is coupled to a device for measuring mechanical parameters (adjustable electromagnetic brake and torque and speed transducer). The recorded values are integrated into a measurement and data storage system, in the form of a dedicated application. **Representative parameters and accuracy** The first category of benches has the following representative parameters: flow rate Q=18-360 m^3/h; water flow velocity in the test pipe section = 0.05-1m/s; adjustable brake shaft diameter = 20 mm; magnetic powder brake torque M= 0.1-1Nm; rotational speed at maximum torque = 400 rev / min; the flow in the test pipe section is stabilized, continuous, permanent and uniform v=± 0.01 v_{med}. The second category of benches has the following representative parameters: upper tank volume = 2400 l; lower tank volume = 3840 l; internal diameter transparent vertical pipe, through which the upper tank communicates with the lower one = 230 mm; pumping group maximum flow rate = 100 l/s, at a drop of H=2.2 m; pump drive motor power / supply voltage / frequency / rotational speed = 7.5 kW / 3x380-415 V / 50Hz / 2900 rpm; rotor diameter of the tested low-head hydraulic turbine = 228 mm. Depending on the theme in the beneficiary's request, benches can be developed with other representative parameters, too.
Deliverables	Execution documentation, physical product, technical book, test procedure.
References	For the first category of benches, for which INOE 2000 - IHP was granted the patent No. RO 131813 / 28.02.2022, a prototype was built and commissioned at the headquarters of the National Institute for Research and Development in Electrical Engineering ICPE-CA Bucharest. For the second category of benches, for which INOE 2000 - IHP will file a patent application, the design of a prototype has been completed, which is in the process of being built, assembled and commissioned at ICPE-CA Bucharest.
Terms of execution	Execution time (6-12 months) and cost vary depending on the complexity of the order. Please contact us for details.
Contact	Website: www.ihp.ro E-mail: office.ihp@fluidas.ro

TESTING AND CONSTRUCTION OF STANDS FOR TESTING HYDRAULIC COMPONENTS

Type of the service	Technological service
Targeted areas	• Area 1 Diagnostics of hydraulic components • Area 2 The realization of test means • Area 3 Maintenance of hydraulic installations

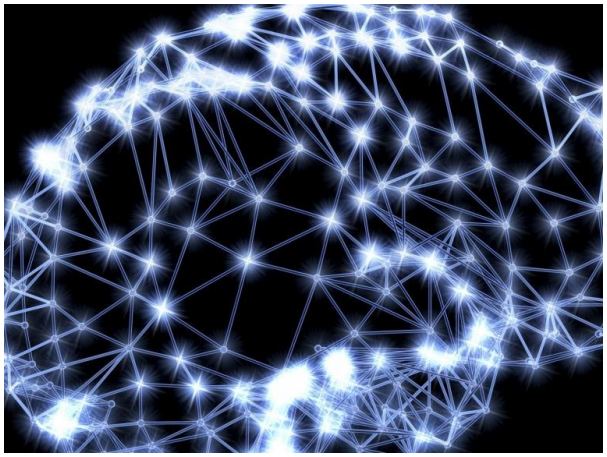
Short description	Performance evaluation of hydraulic components is of great importance for the proper functioning of the systems that contain them. Poor operation is accompanied by high-energy consumption, contamination of the working fluid and the environment, if the working fluid gets outside the circuit. The test means made by our subsidiary can determine the proper operation of hydraulic devices (pumps, motors, adjustment and control elements); by comparing with the initial characteristics the state of wear can be assessed and the duration of good operation can be estimated. Inspection on the stand is also necessary after the repairs have been carried out, to guarantee their quality. The institute analyzes and recommends financing possibilities to beneficiaries through programs addressed to SMEs, which companies can access alone or in partnership.
Type of access	Physical
Access to service	The testing of the components is done at the headquarters of the IHP branch, in the specific laboratories. They are equipped with hydraulic energy generation systems (max. flow 150 l/min, max. pressure 630 bar), which cover most of the equipment in industrial and mobile hydraulics. The data obtained during the tests are recorded, stored and processed with data acquisition systems. Depending on the type of device, the activity is carried out in several dedicated laboratories. Beneficiaries who purchase test stands carry out the activity at the company's own headquarters, after commissioning and staff training. The design of the stands is fully computerized, with software specific to mechanical engineering (Solidworks, Autocad).

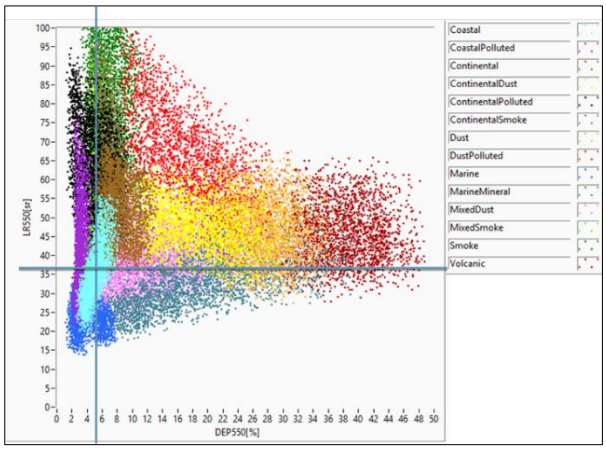
Technical details	**Laboratories and equipment involved** 3 research laboratories are involved in the activities of testing the components and making the stands: ● Electro-hydraulic control equipment (https://ihp.ro/lab_electro-hydraulic_control.htm); ● General hydraulics (https://ihp.ro/lab_Basic_Hydraulic.htm); ● Hydrostatic transmissions (https://ihp.ro/lab_hydro_transmissions.htm). The development of stand projects is carried out in the Servo-technics and Electronics departments and, respectively, in the General Hydraulics department. The physical production of the products is done in the micro-production base or through collaboration with specialized companies. **Applicable standard methods and procedures** The testing of the components is done according to field-specific standards and procedures developed in the institute for each type of component: flow generators, motors (rotary and linear), devices for regulating pressure, flow, etc. Examples of applied procedures / internal code / scope: - Determination of functional parameters in permanent mode. Pressure. Flow / PT – L-01 – 03 / flow generators (pumps) test - External and internal tightness test / PT – L-01 – 01/ linear hydraulic motors test - Determination of the differential pressure-flow characteristic / PT – L-01 – 02 / test of hydraulic distributors **Representative parameters and accuracy** (long text, 1000 chars) The institute's technical capabilities cover most industrial and mobile hydraulics applications with powers up to 55 kW. Tests can be performed at high pressures of up to 630 bar, and in the range of medium pressures (315...350 bar), the working flow rates can be up to 150 l/min. The measuring accuracy of the devices falls within the range of 0.1...0.5%.
Deliverables	Deliverables are divided into 2 categories: 1. Tests carried out in our own laboratories, which present the performance of the devices, and for which experimentation reports are drawn up according to the institute's internal procedures; 2. Test means offered to beneficiaries who carry out activity in the field of maintenance of hydraulic equipment, for their own use or for third parties; they are accompanied by specific technical documentation (technical book, user manual, work procedures, etc.).
References	Beneficiaries of hydraulic component testing services: Visteon Project, RCCF Trans, Medium Electric, Maxim Utilaje, CN ROMARM, Gemini Grup, Electro Vest, etc. Users of stands made by the institute: HIAROM, DSK Hydraulics & Pneumatics, Rolix Impex Series, Politehnica University of Timișoara, etc
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: www.ihp.ro Email: office.ihp@fluidas.ro

CONSULTANCY AND TRAINING

MACHINE LEARNING APPLICATION FOR OPTOELECTRONICS PROCESSESS

Type of the service	Technical-economic service
Targeted areas	• Feature extraction and isolation for optoelectronic measurements using Machine Learning/Artificial Intelligence • Advanced statistical methods for data anatomy evaluation • Fundamental and applied research





Short description	Machine Learning and Artificial Intelligence is proven to be a key factor in physical process evaluation providing specialized insights to the recorded scientific data with an open perspective with regards to the undelaying processes. Such technologies can be applied for feature extraction using both supervised and non-supervised methods (Principal Component Analysis, Least Discriminant Analysis a.s.o) Another key aspect is providing newer technologies (such as vector databases) for knowledge preservation thus providing researchers with important focus points for any specific analysis type. The service targets both research entities in physical sciences with a focus on optoelectronics. The economic sector can benefit for such technologies as well.
Type of access	Hybrid
Access to service	While statistical deterministic and non-deterministic analysis required large volume data to be exchanged we heavily use the private cloud resources present at the Institute facilities thus allowing a full hybrid (online laboratory) access to both initial data and the results obtained from the data allowing full collaboration between the implementation team and beneficiary.

Technical details	**Laboratories and equipment involved** Data processing framework is centered at the existing high availability private cloud and virtual laboratory environment with high capacity distributed full redundancy data store enabling source code management and analysis results representation using standardized presentation environments like Jupyter Notebooks enabling collaboration in online laboratories. The implementation team has specific computing technologies and knowledges providing high quality, fast and accurate results to be obtained. **Applicable standard methods and procedures** Principal Component Analysis Least Discriminant Analysis Supervised Machine Learning Non-Supervised Machine Learning Knowledge representation **Representative parameters and accuracy** Depending on the task at hand data filtering techniques are applied and verify the filtering technique impact on the whole dataset using correlation analysis. For ML/AI models accuracy levels are considered significative for a less than 15% loss.
Deliverables	Accurate and filtered data-sets as a direct result of the data preparation workflow with filtered extension datasets for anomalies providing key insight on the dataset allowing correlation methods to filter out negative anomalies. Studies and technical-scientific analyses for parameters and features identified within the provided dataset. Keynotes on data features and process convolution (for both noise and significant data).
References	Nicolae, D., Vasilescu, J., Talianu, C., Binietoglou, I., Nicolae, V., Andrei, S., and Antonescu, B.: A neural network aerosol-typing algorithm based on lidar data, Atmos. Chem. Phys., 18, 14511–14537, https://doi.org/10.5194/acp-18-14511-2018, 2018
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://www.inoe.ro Email: gianina.chirosca@inoe.ro

BUSINESS AND TECHNOLOGY TRANSFER ASSISTANCE AND CONSULTANCY

Type of the service	Technical-economic service
Targeted areas	• Assistance and consultancy for business innovation and technology transfer to introduce research and development results and innovative products into the economic circuit. • Assistance and consultancy for the protection and valorization of intellectual property rights. • Intermediation activities between the demand for innovative technology and the existing market supply.

Short description	The Technology Transfer Center CENTI, a department operating since 2004 within INCDO INOE 2000, ICIA Cluj-Napoca Branch, ensures: the promotion and capitalization of research and development results (technologies, methods, installations, patents, etc.) through the transfer of high-level scientific and technical knowledge to the economic environment, as well as supporting the business environment with the aim of increasing economic competitiveness, innovation, and the level of retechnologization / advanced technology transfer in Macroregion RO1. Being a member organization of the Enterprise Europe Network (a European network for business consultancy and support) and also a member of the National Network for Innovation and Technology Transfer (ReNITT) and the Romanian Association for Technology Transfer and Innovation (AroT), CENTI ensures the widespread promotion of research and development and business interests.
Type of access	Hybrid
Access to service	Access to business and technology transfer services begins with direct contact with CENTI representatives in order to further analyze the company's needs and gather preliminary data. Subsequently, various suitable service categories are identified and accessed physically or virtually depending on their specifics (e.g., event, fair, business report/analysis, etc.).

Technical details	CENTI offers a wide range of specialized services to the business environment, mainly through: **1.Assistance and consultancy for business innovation and technology transfer to introduce research and development results and innovative products into the economic circuit** - technological audit; innovation management capacity analysis; digital innovation level analysis; sustainability performance analysis; business and marketing plans for the introduction of innovative products/services/technologies to the market. **2.Assistance and consultancy for the protection and valorization of intellectual property rights** - assistance in identifying suitable funding sources to support the company's efforts to protect intellectual property rights (e.g., trademarks, patents, designs, models, etc.); support and assistance in preparing documentation for submitting intellectual property rights applications at the national (OSIM) and European (EUIPO) levels. **3.Intermediation activities between the demand for innovative technology and the existing market supply** - identifying best practice models available internationally; identifying existing technology offers on the market; examining identified offers to determine characteristics, advantages, market launch methods; identifying accredited companies for the verification and validation of innovative products; support for SMEs regarding access to new markets and identifying potential business and innovation partners through company profiles and participation in brokerage events, matchmaking, and company missions.
Deliverables	1.Technological audit report; Innovation management level report; Digital innovation level report; Sustainability performance level report; Business and marketing plan. 2.Consultancy sheet for identifying funding sources; Consultancy sheet for preparing documentation for submitting intellectual property rights applications at the national and European levels. 3.Best practice models catalog; Technology offers catalog; Technical offer sheets; List of accredited companies; Business Offer/Request, Technology Offer/Request, R&D Request profiles; Expressions of interest prepared/received related to published profiles; Participation report at profile events.
References	Between 2022-2023, CENTI Cluj-Napoca supported over 60 SMEs from Transylvania across various industries. Specifically, over 90 services were provided for attracting non-reimbursable European funds, 78 services for creating and disseminating profiles to identify foreign business partners, and over 10 services for innovation assistance. The results included 22 concluded non-reimbursable funding contracts, 10 partnership agreements for production or distribution on international markets, 6 trademark applications submitted at the European level, and 2 applications submitted at the national level.
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: CENTI, Enterprise Europe Network; Email: centi@icia.ro

COURSES IN THE FIELD OF HYDRAULIC ACTUATIONS

Type of the service	Technical-economic service
Targeted areas	• Area 1 Hydraulic and Pneumatic Equipment and Installations • Area 2 Mechatronics and Robotics • Area 3 Tribology

Short description	Organizing training courses in the field of hydraulic actuation is based on identifying the training needs of potential participants, their current level of knowledge, and the competencies they wish to develop or improve. The course content is then developed to align with the identified needs of the participants.
Type of access	Hybrid
Access to service	Courses can be held both physically at the institute's headquarters in a dedicated classroom and online through specific platforms. The institute's laboratories allow for practical work to be conducted using dedicated teaching stands aimed at achieving the competencies described within the course program. The courses conclude with the evaluation of the participants and the issuance of participation diplomas that demonstrate the acquisition of competencies.

Technical details	**Laboratories and equipment involved** In the learning activities regarding hydraulic and pneumatic actuation, all research laboratories are involved: - Electro-Hydraulic Control Equipment (https://ihp.ro/lab_electro-hydraulic_control.htm) - General Hydraulics (https://ihp.ro/lab_Basic_Hydraulic.htm) - Hydrostatic Transmissions (https://ihp.ro/lab_hydro_transmissions.htm) - Sealing Elements (https://ihp.ro/lab_sealing.htm) - Pneumatics Laboratory (https://ihp.ro/lab_pneumatic.htm) - Mechatronics Laboratory (https://ihp.ro/lab_mecatronics_en.htm) **Applicable standard methods and procedures** The teaching methods for the courses are standard, involving: 1. Lecture delivery: Providing information presented in the course materials. 2. Discussion based on course materials: Engaging in discussions based on the course content. 3. Application of presented concepts: Applying the presented concepts to real-world scenarios. 4. Demonstration of concepts: Illustrating concepts using specialized stands in the Institute's laboratories. **Representative parameters and accuracy** The technical capabilities of the institute cover most of the applications in industrial and mobile hydraulics and pneumatics, with power ratings of up to 55 kW. Tests can be conducted at pressures (high) of up to 630 bar, and in the field of medium pressures (315…350 bar), flow rates can be up to 150 l/min. The measurement accuracy of the devices falls within the range of 0.1…0.5%.
Deliverables	Course materials; Certificate of participation
References	Over time, the Institute has organized courses both at its headquarters and at the premises of companies interested in training their staff. Over 500 individuals have been trained from more than 25 companies in the field.
Terms of execution	Execution time and cost vary depending on the complexity of the order. Please contact us for details. The intellectual property rights over the outcomes of the service are discussed and decided upon at the time of contract signing.
Contact	Website: https://ihp.ro/cursuri-de-perfectionare-profesionala Email: fluidas@fluidas.ro

Whether you are looking for assistance in optical design, investigation of cultural heritage objects, analysis or creation of special materials, environmental monitoring, validation or use of satellite data products, obtaining biofuels or the development of prototypes involving optoelectronic techniques, INOE has the knowledge and tools to help you reach your goals. Contact us to find out more about how we can collaborate on your next project.

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