



■ ■ **Researchers and Students**

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■ ■ **Research topics**

*X-ray Absorption Spectroscopy*

- Extended X-ray Absorption Fine Structure (EXAFS) and X-ray Absorption Near Edge Structure (XANES) Data Analysis and Computer Modeling
- Measurements of X-ray Absorption Spectra using Synchrotron Radiation

*Confocal Spectro-Microscopy*

- Optical and Confocal Microscopy
- Raman and Luminescence Spectroscopy
- 0D, 1D, 2D and 3D High-speed Imaging and Spectroscopy

*Scanning Probe Spectro-Microscopy*

- Atomic Force Microscopy
- Scanning Probe Spectromicroscopy
- Nanolithography

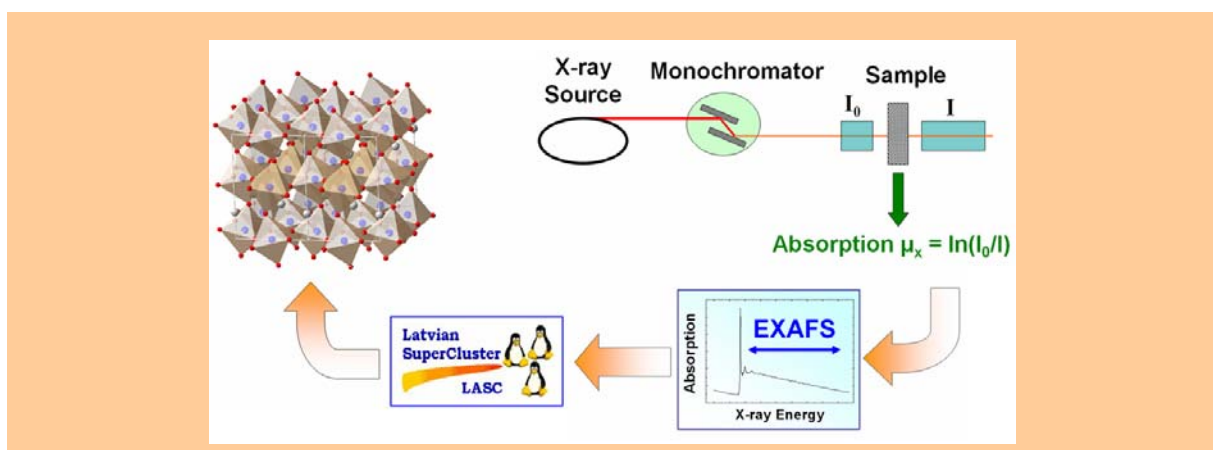
*Nanostructured Materials*

- Thin Films (nanostructured, amorphous and crystalline), Glasses and Crystals containing Transition Metal (TM) and Rare-Earth (RE) Ions
- Samples Preparation by Magnetron Sputtering, Thermal Evaporation, High-Temperature Sintering, Chemical Vapor Deposition, Reactions in Solutions, etc.

■ ■ **Description of research directions**

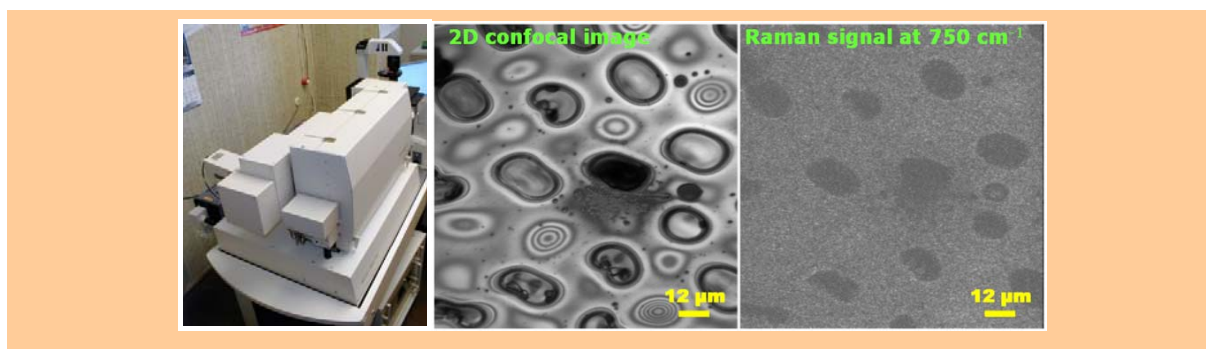
*X-ray Absorption Spectroscopy (EXAFS & XANES)*

EXAFS Spectroscopy Laboratory is involved in the research and development of new nano-sized materials, new experimental methods as well as new procedures for x-ray absorption spectra data analysis. We use complex approach based on a combination of modern experimental techniques with advanced data analysis methodologies, including the use of high performance cluster computing.



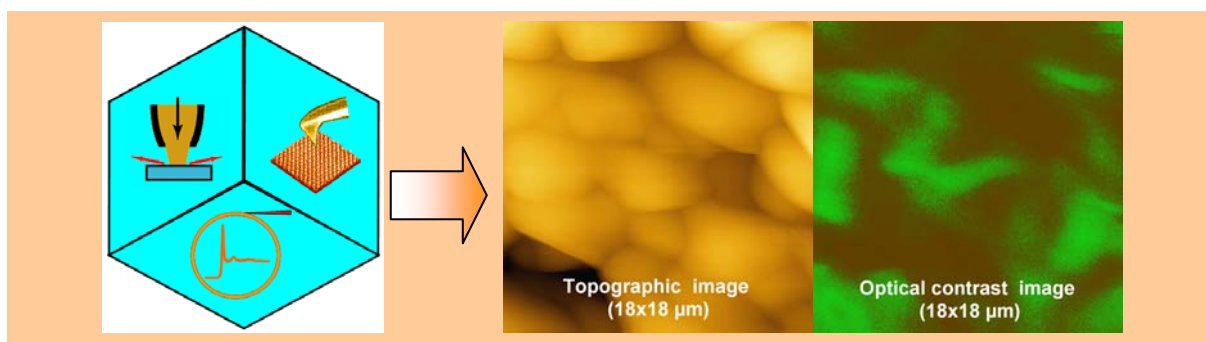
*Confocal Spectro-Microscopy*

3D scanning confocal microscope with spectrometer „Nanofinder-S” is a system, composed of optical confocal microscope, spectrometer, laser source, scanner and detection system with computer control. We use it to perform studies with submicrometer resolution (about 250-500 nm) in solid compounds, thin films, biological materials, etc. „Nanofinder-S” is used for simultaneous and multifunctional analysis by optical and confocal microscopy; Raman and luminescence spectroscopy; 0D, 1D, 2D and 3D high-speed imaging with spectroscopy.



### Scanning Probe Spectro-Microscopy

Near-Field X-ray Spectro-Microscopy is a fully new approach for the detailed investigation of nanostructures down to the nanometer level. The extremely high lateral resolution of Scanning Probe Microscopies (SPM), as AFM, STM and SNOM, makes them among the most largely used in nanoscience. However, these tools suffer of a lack in chemical sensitivity. On the other hand, far field X-ray Spectroscopy probes the chemical and structural properties of materials. Therefore, a combination of X-rays spectroscopies and SPM is the ideal answer to many structural problems in nanoscience.



### International cooperation

The Laboratory collaborates with several European universities and research centers as University of Trento (Italy), Institute for Photonics and Nanotechnologies (Trento, Italy), CRMCN/CNRS, Mediterranean University, (Marseille, France), Joint Institute for Nuclear Research (Dubna, Russia), University of Calabria (Arcavacata di Rende, Italy).

### Main publications

- J. Purans, N.D. Afify, G. Dalba, R. Grisenti, S. De Panfilis, A. Kuzmin, V.I. Ozhogin, F. Rocca, A. Sanson, S.I. Tiutiunnikov and P. Fornasini, Isotopic effect in extended x-ray-absorption fine structure of germanium, *Phys. Rev. Lett.* 100 (2008) 055901:1-4.
- S. Larcheri, F. Rocca, F. Jandard, D. Pailharey, R. Graziola, A. Kuzmin and J. Purans, X-ray excited optical luminescence detection by scanning near-field optical microscope: a new tool for nanoscience, *Rev. Sci. Instrum.* 79 (2008) 013702 (9 pp.).
- M. Vračar, A. Kuzmin, R. Merkle, J. Purans, E. A. Kotomin, J. Maier, O. Mathon, Jahn-Teller distortion around  $\text{Fe}^{4+}$  in  $\text{Sr}(\text{Fe}_x\text{Ti}_{1-x})\text{O}_{3-\delta}$  from x-ray absorption spectroscopy, x-ray diffraction, and vibrational spectroscopy, *Phys. Rev. B* 76 (2007) 174107:1-12.
- N. D. Afify, G. Dalba, C. Armellini, M. Ferrari, F. Rocca, A. Kuzmin, Local structure around  $\text{Er}^{3+}$  in  $\text{SiO}_2\text{-HfO}_2$  glassy waveguides using EXAFS, *Phys. Rev. B* 76 (2007) 024114:1-8.
- A. Kuzmin, R. Kalendarev, A. Kursitis, J. Purans, Confocal spectromicroscopy of amorphous and nanocrystalline tungsten oxide films, *J. Non-Cryst. Solids* 353 (2007) 1840-1843.
- J. Purans, A. Kuzmin, E. Cazzanelli, G. Mariotto, Disorder-induced Raman scattering in rhenium trioxide  $\text{ReO}_3$ , *J. Phys.: Condens. Matter* 19 (2007) 226206 (8pp).
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- V. L. Aksenov, M. V. Kovalchuk, A. Yu. Kuzmin, Yu. Purans, S. I. Tyutyunnikov, Development of methods of EXAFS spectroscopy on synchrotron radiation beams, *Crystallography Reports* 51 (2006) 908-935 [Review].

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