

COST Action MP1302 Nanospectroscopy
Training School on Raman Spectroscopy, Zagreb, Croatia, September 23-25, 2015

School Program 1st day, section Raman spectroscopy of molecules and crystals, SERS

Morning 8:30 to 12:30

Mile Ivanda

Historical introduction of the Raman spectroscopy

Vlasta Mohaček Grošev

Theory of Raman spectroscopy on molecules and crystals

- Vibrations of molecules
- Normal coordinate calculations
- Basic theory of symmetry and applications to the Raman scattering on molecules and crystals
- Examples of the complete solutions of vibrational analysis on small molecules and simple crystals

Vedran Đerek and Lara Mikac

Surface enhanced Raman spectroscopy and applications

- Introduction to plasmonics
- Raman scattering enhancement by localized plasmonic resonances and coupled plasmonic resonances
- Preparation of SERS active materials (metallic colloidal suspensions, metallic nanoparticles grown on silicon substrates)
- SERS measurements in micro and macro Raman configurations –possible applications and limitations

Afternoon 14:30 to 18:30

Raman spectroscopy practicum by the Raman spectrometer Jobin Yvon T64000

- Description of the instrument
 - i) Laser excitations
 - ii) Macro Raman scattering chamber
 - iii) Micro Raman scattering technique
 - iv) CCD and photomultiplier signal detections
- Methods of measurements
 - i) 90° geometry and back scattering measurements
 - ii) additive and subtractive spectrometer configurations
 - iii) polarisation measurements
 - iv) temperature dependent measurements using Linkam
 - v) practicum on specific cases of Raman scattering on molecules and SERS

School Program 2nd day, Raman spectroscopy on nanoparticles and disorder materials

Morning 8:30 to 12:30

Mile Ivanda

Raman spectroscopy of nanoparticles

- Introduction to the vibrations of nanoparticles
- Spherical acoustic vibrational modes
- Phonon confined effects and Raman scattering of optical modes of nanoparticles
- Different examples of applications – free and matrix embedded nanoparticles, Raman scattering on acoustic and optical modes of nanoparticles

Davor Ristić

Raman scattering on disordered materials

- Selection rules in Raman scattering of disordered materials
- Raman scattering on glasses and amorphous materials
- Boson peak in Raman spectra – comparison to other experimental techniques
- Raman scattering on fractons

Prof. Philippe Colomban, guest speaker from UPMC Paris, France

Raman Spectroscopy of advanced materials (fibre, composites, films ...) for aerospace and energy application

Afternoon 14:30 to 18:30

- 1) Practicum of low frequency Raman spectroscopy on different nanostructured and disordered materials
 - free nanoparticles of metal oxide and semiconductor nanoparticles (TiO₂, SnO₂, ZrO₂, CdS, Si)
 - nanoparticles embedded in matrix (Si in SiO₂)
 - porous silicon
 - disordered materials (amorphous silicon, silica, halcogenide glasses)

School Program 3rd day, Selected complementary techniques to Raman spectroscopy

Morning 8:30 to 11:30

Hrvoje Skendereović, Institute of Physics, Zagreb

Time-resolved techniques with ultrashort pulses in examination of specific vibrational states of matter

Marina Kveder, Laboratory for Magnetic Resonances, RBI

Application of ESR spectroscopy in probing of vibrational states of disordered materials

Goran Baranović, Laboratory of Molecular Spectroscopy, RBI

Experimental methods and applications of Fourier-Transform-Infra-Red (FTIR) Spectroscopy

Afternoon 13:30 to 18:30

- 1) Visit to Laboratory for Femtosecond Laser Spectroscopy, Institute of Physics; demonstrations of pump and probe technique, measurements, signal processing and interpretations
- 2) Visit to Laboratory for Magnetic Resonances, RBI, demonstrations of ESR spectroscopy technique, measurements, signal processing and interpretations
- 3) Visit to Laboratory of Molecular Spectroscopy, RBI, demonstrations of FTIR spectroscopy technique, measurements, signal processing and interpretations