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, Lecture hall 1 of Ruđer Bošković Institute (RBI)

8:30 Mile Ivanda
Welcome Address
Historical introduction of the Raman spectroscopy

9:30 Vlasta Mohaček Gorošev
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

10:30 – 10:50 Break

10:50 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 Lab, Wing VI of RBI
Raman spectroscopy practicum by the Raman spectrometer Jobin Yvon T64000
Group 1: Description of the instrument and measurements (D. Ristić and H. Gebavi)
   i) Laser excitations
   ii) Macro Raman scattering chamber
   iii) Micro Raman scattering technique
   iv) CCD and photomultiplier signal detections
   v) 90° geometry and back scattering measurements
   vi) Additive and subtractive spectrometer configurations
   vii) Polarization measurements
   viii) Raman spectroscopy of c-Si, a-Si, SiO2, SiOx,

Group 2: Methods of measurements and preparation (V. Mohaček, L. Mikac, V. Đerek)
   i) Description of temperature dependent measurements using Linkam
   ii) Preparation of SERS substrates
School Program 2nd day, Raman spectroscopy on nanoparticles and disorder materials

Morning 8:30 to 12:30, Lecture hall 3 of Ruđer Bošković Institute

8:30 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

9:20 Davor Ristić
Raman scattering on disordered materials
- Selection roles 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

10:10 – 10:30 Break

10:30 Prof. Philippe Colomban, guest speaker from UPMC Paris, France
Raman Spectroscopy of advanced materials (fibre, composites, films ...) for aerospace and energy application

11:30 Josef Sedlmeier, Renishaw
Raman AFM solution for Nanomaterials research from Renishaw/Bruker

Afternoon 14:00 to 16:30, Raman Lab, Wing VI of RBI

Group 1: Practicum of low frequency Raman spectroscopy on different nanoparticles (D. Ristić, H. Gebavi, M. Ivanda)
   i) Free nanoparticles of metal oxide and semiconductor nanoparticles (TiO2, SnO2, ZrO2, CdS)
   ii) Nanoparticles embedded in matrix (CdSxSe1-x in Schott glass, Si in SiO2)
   iii) Porous silicon

Group 2: Preparation of colloidal silver for SERS, CVD techniques (L. Mikac, V. Derek)

17:00 PICNIC for all participants of the School, in the front of the RBI restaurant (near swimming pool).
School Program 3rd day, selected complementary techniques to Raman spectroscopy

Morning 8:30 to 11:30

8:30 Hrvoje Skendereović, Institute of Physics, Zagreb
Time-resolved techniques with ultrashort pulses in examination of specific vibrational states of matter

9:20 Marina Kveder, Laboratory for Magnetic Resonances, RBI
Application of ESR spectroscopy in probing of vibrational states of disordered materials

10:10 – 10:30 Break

10:30 Goran Baranović, Laboratory of Molecular Spectroscopy, RBI
Experimental methods and applications of Fourier-Transform-Infra-Red (FTIR) Spectroscopy

Afternoon 13:30 to 18:30; Guided visits in 3 groups to the following laboratories (meeting point near swimming pool)

1) Laboratory of Molecular Spectroscopy, RBI, demonstrations of FTIR spectroscopy technique, measurements, signal processing and interpretations, Goran Baranović

2) Laboratory for Magnetic Resonances, RBI, demonstrations of ESR spectroscopy technique, measurements, signal processing and interpretations, Nadica Maltar Strmečki

3) Laboratory for Femtosecond Laser Spectroscopy, Institute of Physics; demonstrations of pump and probe technique, measurements, signal processing and interpretations, Hrvoje Skendereović