Laboratories at INTiBS PAN available for WSD IPAN students' practice

Division of Optical Spectroscopy:

1. Laboratory of Optical Spectroscopy I - IITD
Contact: dr hab. P. Solarz (p.solarz@intibs.pl)
Group: max. 2 persons
Duration: 3x3 hours
Description:
Students will learn about gas, solid-state, and semiconductor lasers and the operation of monochromators, detectors, and operating an oscilloscope. Then the following measurements will be presented:
1. Excitation spectra, the influence of temperature on the excitation spectra.
2. Emission spectra, temperature influence on the emission spectra.
3. Determining the lifetime of metastable levels. Interpretation of luminescence decay curves.
4. Up-conversion processes of radiation, that is, using a specific system of lanthanide levels to obtain visible light by pumping infrared.

2. Laboratory of IR and Raman Spectroscopy
Contact: dr hab. Maciej Ptak (m.ptak@intibs.pl)
Group: 2-3 persons
Duration: 2 – 3 hours
Description:
During the practical training, PhD students will learn how to measure IR (transmission, reflectance, ATR) and Raman (also in polarized light) spectra of solid (monocrystalline, powder) and liquid samples. The basic theory and analysis of the obtained spectra using correlation methods and group theory will be discussed. PhD students are encouraged to bring their own samples and perform IR and Raman spectra on their own.

3. Laboratory of Optical Spectroscopy II - IITD
Contact: dr Karol Lemański (k.lemanski@intibs.pl)
Group: max. 3 persons
Duration: 3 – 4 hours
Description:
Students will be able to participate in spectroscopic measurements, such as luminescence spectra, excitation, quantum yield, emission decay times. Under supervision, they will be able to assemble the optical system and operate the measuring equipment. When using a laser, it will be imperative to follow the health and safety rules.

4. Laboratory of Absorption Spectroscopy
Contact: dr Bogusław Macalik (b.macalik@intibs.pl)
Group: max. 2 persons
Duration: 2 – 3 hours
Description:
Practice will Students consist in measuring optical absorption spectra for transparent liquid or solid samples or diffusion scattering spectra for powder samples. You will be able to measure their research material.

5. Chemical laboratory - universal sol–gel method
Contact: dr hab. Anna Łukowiak (a.lukowiak@intibs.pl)
Group: max. 4 persons
Duration: 4 – 7 hours
Description:
The sol–gel technology offers possibility to fabricate different kind of materials — glass or crystals, powders, thin films, fibers, or monoliths, dense or porous structures, pure or doped matrices, as well as inorganic or organic-inorganic hybrid materials. During course, students will synthesize different kind of materials (selected among silica glasses, hybrid oxides, oxides doped with optically active materials, and others). They will gain basic knowledge about sol–gel reactions, parameters defining final form of a product, and possibilities of materials functionalization.

Division of Magnetic Research:

1. Laboratory of Crystal Growth
Contact: dr Orest Pavlosiuk (o.pavlosiuk@intibs.pl)
Group: max. 2 persons
Duration: 2x5 hours
Description:
Growth of single crystals of intermetallic compounds using the flux method. This part of the practice will include: an overview of the most important aspects of the synthesis method; making weights of chemical elements using a precise laboratory balance, work in a glove box; ampoule evacuation; selection of the appropriate temperature synthesis regime and programming of the temperature controller.

The next tasks will be: checking the quality of single crystals and their orientation along certain crystallographic directions using a Laue camera, preparing samples from single crystals for measuring electrical resistance (cutting a crystal on a laboratory wire saw, grinding samples, applying electrical contacts).

Students will be able to carry out all the proposed activities on their own under supervision.

2. Laboratory of Magnetic Measurements
Contact: dr Maria Szlawska (m.szlawska@intibs.pl)
Group: max. 2 persons
Duration: 5 - 10 hours
Description:
Technology laboratory: cutting samples and preparing them for measurements (preparation of contacts for electrical measurements, assembly of samples to measuring holders) - independent work.

Laboratory of magnetic measurements and laboratory of transport and thermal properties measurements (squid magnetometers): description of measuring devices, inserting samples into cryostats, selecting and switching on the measurement program, assistance in flooding cryostats with cryogenic liquids, preliminary analysis, and discussion of the obtained results.

3. Laboratory of Crystal Growth - Czochralski method
Contact: dr Magdalena Majewicz (m.majewicz@intibs.pl)
Group: max. 3 persons
Duration: 2x4 hours
Description:
Sample preparation, crystal growth with the Czochralski method in a four-arc furnace, determination of the quality and orientation of the crystal using the Laue method, crystal cutting for further measurements. At all stages of the process, students will be able to do something on their own.

Division of Low Temperatures and Superconductivity

1. Temperature Standard Laboratory - IITD
Contact: dr Aleksandra Kowal (a.kowal@intibs.pl)
Group: max. 6 persons
Duration: 2 – 4 hours
Description:
Practical methods of temperature determination, calibration of thermometers, presentation of the national temperature standard

2. Laboratory of Superconductivity Research
Contact: dr Lan Maria Tran (l.m.tran@intibs.pl)
Group: max. 2 osoby
Duration: min. 4 hours max. 30 hours
Description:
Studies of magnetic properties and electric transport in selected superconductors and magnetics. Students will have the opportunity to learn about the methodology of magnetic research (AC susceptibility, magnetization) and electric transport (resistance,

magnetoresistance, Hall effect measurements) - preparation of samples for measurements, measurement settings, methods of results processing.

In the "basic" version (4 h), students will familiarize themselves with the research topics conducted in the laboratory and the basic techniques used for research. The principles of measurement will be briefly discussed. Students will have the opportunity to prepare samples for measurements and, depending on the date, they will have the chance to set up a transport or magnetic measurement. Students will be informed about the dangers of testing at low temperatures and high magnetic fields.

Along with the extension of classes, students will:
• become acquainted with the principles of operation of measurements and measuring apparatus;
• learn what information about the material can be obtained using the research methods used;
• participate in the analysis of experimental results.
The extended practice is intended for students genuinely interested in solid-state research using magnetic measurements and electric transport.

3. Laboratory of Thermal Properties of Solids
Contact: dr Daria Szewczyk, dr hab. Piotr Stachowiak (d.szewczyk@intibs.pl; p.stachowiak@intibs.pl)
Group: max. 2 persons
Duration: min. 2x4 hours, max. 2 weaks
Description:
As part of the proposed topic "Research on specific heat and the phenomenon of heat transport in solids", it is proposed to familiarize yourself with the measurement possibilities of the Laboratory. In the introductory part, presentation of the available measuring stations is planned:
- equipment for measuring the thermal conductivity
- using the stationary method of axial heat flow - unique multi-purpose helium cryostats for the low-temperature range
- using the surface transmission heat source method - HOT DISK commercial stand - used at room temperature and above (up to 500C); intended mainly for medium and large-size samples
- using the dynamic method - a commercial stand, Physical Property Measurement System from Quantum Design, working in the TTO heat transport option, operating in the range from 1.8K to 400K - (here, the stationary method of determining the thermal conductivity coefficient can also be used)
- using the 3ω method - specialized measuring system working from 50K - 340K - designed for thin-film samples
- station for determining the specific heat value - commercial PPMS from QD, optional

specific heat HC - temperature range 1.8K-400K

Introduction to the laboratory practice covers the theory of heat transport in materials and methods for determining individual thermal properties.

During an extended practice, students will have a chance of:
- participation in the assembly of samples and the preparation of thermal conductivity measurements using the stationary method (here the time is divided, assembly about 1-3 hours with breaks resulting from glue drying, pumping of the system, etc., software for the beginning of measurements 0.5-2 hours, optimization of initial conditions) - here the whole measurement takes about week;
- comprehensive measurements using the transient plane source method - 2h / sample + processing of the results
- preparation of specific heat measurements (the entire measurement takes about 3- 3.5 days, including 1-day preliminary measurement + 2 - 2.5 proper measurements)
- analysis of the obtained measurement data (or based on the results obtained in the laboratory) and presentation of information that can be obtained on their basis

4. Laboratory of Strong Magnetic Fields at Gajowicka street
Contact: dr hab. Jacek Ćwik, dr Yurii Koshkidko, dr Daniel Gajda (j.cwik@intibs.pl; y.koshkidko@intibs.pl; d.gajda@intibs.pl)
Group: max. 3 persons
Duration: 5 to 30 days
Description:
Research on the magnetocaloric effect and application characteristics of high-temperature superconductors with the use of the Bitter electromagnets.

The students will be acquainted with the methodology of the work of the Bitter Electromagnet Group. Automation of electromagnetic measurements will be presented. The research conducted with the use of direct measurement methods of the magnetocaloric effect and superconducting properties will be discussed. Depending on the measurement possibility, students will participate in experiments. Additionally, they will be introduced to the latest achievements in the field of magnetocaloric effect research and in the field of superconductivity.

5. Chemical Laboratory
Contact: dr Michał Babij (m.babij@intibs.pl)
Group: max. 2 persons
Duration: up to 30 days
Description:
Chemical synthesis in various gas atmospheres and under vacuum conditions.

During the course, students will have the opportunity to work in a dry argon glove box and will learn the techniques of glass and quartz processing and the use of these materials in chemical synthesis as "reaction vessels". If interested, they will be able to carry out experiments-syntheses in the flow of gases (argon, oxygen, helium, nitrogen, ammonia, carbon dioxide, etc.) at temperatures up to 1200 degrees Celsius. Additionally, if someone would be interested in synthesis with the use of salt or metal fluxes, such syntheses will be able to be performed. Knowledge of these techniques is beneficial in the synthesis of intermetallic compounds, alloys - "open-shell systems".

Division of Structure Research:

1. Laboratory of Thermal Analysis (TG and DSC)
Contact: dr hab. Marek Drozd (m.drozd@intibs.pl)
Group: max. 4 persons
Duration: 2 hours
Description:
During the practice, participants will learn about selected methods of thermal analysis (differential scanning calorimetry (DSC) and thermogravimetry (TG)). Both methods will be used to quickly detect phase transformations occurring in molecular crystals in the temperature range of 100 – 300 K. The participants will prepare single-handed samples and carry out measurements of thermodynamic properties to determine the temperature and nature of phase transformations in selected molecular crystals.

2. Laboratory of X-ray analysis (single crystals)
Contact: dr Vasyl Kinzhybalo (v.kindzhybalo@intibs.pl)
Group: max. 4 persons
Duration: 2 hours
Description:
During the practice, X-ray diffraction measurements will be carried out on monocrystalline samples using an Oxford Diffraction Xcalibur four-circle diffractometer with an Atlas CCD detector, equipped with an Oxford Cryosystems 800 temperature attachment. Students will be able to select and prepare a sample for the study under a stereoscopic microscope, analyze the measurement results, solve and refine the crystal structure of the sample. The use of students' own single-crystalline samples is encouraged.

3. Laboratory of X-ray analysis (powders) - IITD
Contact: dr hab. Anna Gągor (a.gagor@intibs.pl)
Group: max. 4 persons
Duration: 4 hours
Description:
An introduction to powder X-ray diffraction. Students will be involved in the experiment and basic data processing including preparation of samples, operation of the XPertPRO powder

diffractometer, phase analysis, unit cell refinement, Rietveld refinement and calculation of the crystallites' size.

Division of Nanomaterials Chemistry and Catalysis:

1. Laboratory of Transmission Electron Microscopy - IITD
Contact: Dr hab. Małgorzata Małecka (m.malecka@intibs.pl)
Group: max. 3 persons
Duration: 4 hours
Description:
Demonstration of the preparation of samples for measurement.
Demonstration of the capabilities of the Philips CM-20 microscope (student's own samples may be observed after prior contact with the instructor).

2. Laboratory of Scanning Electron Microscopy and Microanalysis - IITD
Contact: dr Damian Szymański (d.szymanski@intibs.pl)
Group: max. 3 persons
Duration: 4 hours
Description:
The Laboratory is equipped with a scanning electron microscope FEI Nova NanoSEM 230. This instrument gives the possibility to image weakly conductive samples without the need of special preparation (e.g. coating of a conductive material) and elemental analysis or chemical characterization by using Energy Dispersive X-ray spectroscopy. In addition the microscope is equipped with Electron Backscatter Diffraction (EBSD) providing information on the crystal structure of the samples.
During the course, the specimen stubs and mounts as well as typical methods of samples preparation for SEM measurement will be presented. In addition, students will have the opportunity to measure their own samples (please deliver a minimum of 2-3 day in advance) and operate the electron microscope.

2. Characterization of porous materials and nanomaterials by nitrogen adsorption at 77 K.
Contact: dr Piotr Kraszkiewicz (p.kraszkiewicz@intibs.pl)
Group: max. 3 persons
Duration: 2x2 hours
Description:
Nitrogen adsorption at 77 K is a commonly used method for characterizing porous materials and nanomaterials to determine their specific surface area, as well as pore size and volume. During the practice, participants will participate in the nitrogen adsorption measurement, learn about the most important issues related to the measurement, and analysis of the obtained results.
The specificity of the measurement requires dividing the practice into two days: sample preparation and measurement (about 4 hours in total)

Division of Biomedical Physicochemisty:

1. Application of FRET type biosensors in spectroscopical studies - IITD
Contact: Prof. A. Bednarkiewicz (a.bednarkiewicz@intibs.pl)
Group: max. 3 persons
Duration: 4 hours
Description:
Spectroscopic studies of core-shell fluoride materials: emission, excitation-emission, and lifetime.

2. Supersensitive luminescence thermometers
Contact: dr hab. Ł. Marciniak (l.marciniak@intibs.pl)
Group: max. 3 persons
Duration: 4 hours
Description:
Spectroscopic studies of inorganic materials: temperature dependence of emission and lifetimes.

3. Studies of inorganic biomaterials – potential tissue fillers in implantology and aesthetic medicine - IITD
Contact: prof. Rafał Wiglusz (r.wiglusz@intibs.pl)
Group: max. 3 persons
Duration: 5 hours
Description:
Synthesis and physicobiochemical investigations of inorganic biomaterials: structure, morphology and confocal microscopy.