

## #011

**Title:** Basics in modern high-pressure techniques

**Abstract:**

The main goal of the internship is familiarizing the participants with the Diamond Anvil Cell (DAC) and the fundamental procedures of the high pressure technique, such as preparation of the gasket, hole drilling on the gasket, and measurement of the pressure.

**Contact person(s):** Haijing Meng

**Time requirements:** 2 days, 10-11 hours

**Remarks:** Please contact the indicated person at least 2 weeks prior to the expected internship date.

.

---

## #021

**Title:** Determination of thickness and optical parameters of thin solid films using spectral ellipsometry

**Abstract:**

The goal of the training involves determination of (1) thickness of self-assembled layers of long-chain thiols on the gold support and (2) thickness and optical parameters of thin films of polymers with spectral ellipsometry. To achieve the first goal, gilded glass slides will be coated by thin self-assembled layer of thiol by adsorption from solution. To achieve the second goal, a film of polyacrylic acid will be deposited on a solid support by drop-coating or spin-coating. The prepared polymer samples will be examined by spectral ellipsometry. The ellipsometric spectra recorded, in combination with mathematical modeling, will be used to determine the thickness of self-assembled monolayers as well as thickness and optical properties of the polymer films.

**Contact person(s):** Krzysztof Noworyta and Paweł Borowicz

**Time requirements:** one day, 6-8 hours (plus 1-2 hours a day before)

**Remarks:** Please contact any of the persons indicated above at least 4 weeks before the expected training day.

---

## #022

**Title:** Property studies of monomolecular films at the air-water interface

**Abstract:**

The main goal of the training is (1) to acquaint the students with a method of monomolecular film preparation at the air-water interface (so called Langmuir films) and (2) to study morphology and electrical properties of this film. The students will simultaneously record the surface pressure and surface potential compression-expansion isotherms of selected long-chain aliphatic acids (fatty acids). Moreover, they will study morphology of these films with the use of Brewster Angle microscopy (BAM). From the isotherms recorded the students will subsequently calculate thermodynamic parameters of the studied films.

**Contact person(s):** Krzysztof Noworyta and Karolina Gawecka

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the persons indicated above at least 4 weeks before the expected training.

---

## #023

**Title:** Application of cyclic voltammetry for determination of stability constants of complex formation

**Abstract:**

The aim of the exercise is to study complex forming tendency of selected ligands and metals in aqueous solutions. During the exercise, stability constants and coordination number of pyrazole complex of cadmium (II) will be determined. In view of reversible redox process of cadmium (II) at the hanging mercury drop electrode, the cyclic voltammetric peak of Cd (II) will be used to investigate complex formation with help of Lingane's method.

**Contact person:** Valerii Malyshev

**Time requirements:** Max. 6-7 hours

**Remarks:** Please contact the indicated person at least 4 weeks prior to the expected internship date.

---

## #041

**Title:** Preparation and characterisation of thin graphene films

**Abstract:**

The goal of this laboratory is to use electrochemical methods to obtain thin graphene films on the electrode surfaces and to study their physicochemical properties. A thin graphene oxide film will be electrophoretically deposited on an ITO electrode and electrochemically reduced. The properties of the obtained material will be studied using UV-Vis and electrochemical impedance spectroscopies (EIS).

**Contact person(s):** Joanna Niedziółka-Jönsson, Adam Leśniewski

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 2 weeks prior to the expected internship date.

---

## #061

**Title:** NMR investigations on molecular structure and dynamics in liquids

**Abstract:**

The goal of this workshop is to (1) get familiar with the typical applications of NMR technique used for investigations on molecular structure in liquids (i.e. analysis of 1- and 2-dimensional NMR spectra of various types), and (2) get familiar with some less typical applications of NMR spectroscopy used for investigations of slow and very fast molecular dynamics. In point (2) nuclear spin relaxation techniques are exploited along with numerical lineshape analysis.

**Contact person(s):** Piotr Bernatowicz

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected workshop date.

---

## #101

**Title:** Single crystal X-ray diffraction

**Abstract:**

The goal of this laboratory internship is to get familiar with the XRD technique and structure analysis a) what it can tell us (and what can not) b) how to interpret the structure c) the use of CSD - Cambridge Structural Database.

The whole procedure will be performed [for sucrose or other compound]: starting from single crystal preparation , data collection, structure solution and refinement up to the structure visualization and interpretation.

**Contact person(s):** Roman Luboradzki

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact the indicated perso at least 1 week prior to the expected date.

---

## #102

**Title:**

Fluorescence correlation spectroscopy measurements in complex systems

**Abstract:**

The goal:

1. To learn how to prepare samples and to perform measurements by means of fluorescence correlation spectroscopy;
2. Measurements of diffusion coefficients of chosen fluorescent probes in the model complex fluids (polyethylene glycol and/or dextran solutions).

**Contact person(s):**

Tomasz Kalwarczyk  
Krzysztof Sozański

**Time requirements:**

Two days , 12-16 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #103

**Title:** Determination of the ligand-macromolecule association constant by Flow Injection Analysis

**Abstract:**

The goal of this laboratory internship is to (1) get familiar with the new method allows to determine interaction between different types of the ligand (for example drugs) with the bovine serum albumin (2) to get familiar with the two spectroscopic types of detection (UV-vis and fluorescence).

**Contact person(s):** Aldona Majcher, Anna Lewandrowska

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #104

**Title:** Rheological characterization of chemical substances

**Abstract:**

The aim of the internship is to familiarize PhD students with the rheological measurements allowing to characterize flow properties of a range of substances, used both in a chemical laboratory (eg. aqueous solutions of polymers) and in everyday life. Classification of the samples will be carried out according to their rheological properties: Newtonian, non-Newtonian, pseudoplastic, dilatant, and thixotropic fluids. During the internship, PhD students will familiarize with measurements performed using a "falling ball" instrument and a rotational rheometer.

**Contact person(s):** Agnieszka Wiśniewska

**Time requirements:** 2 days, 16 hours

**Remarks:** Please contact the indicated person at least 4 weeks prior to the expected internship date.

---

## #111

**Title:** Droplet formation in T-junctions using visual feedback

**Abstract:**

The goal of this laboratory is to get familiar with the mechanism of droplet formation in microfluidic T-junctions with the use of LabVIEW program. Usually droplets are formed in T-junctions using continuous flows of two phases or using external electromagnetic valves. In the second case times of opening and closing valves determine length of droplets. However in more complex systems, where the hydrodynamic resistance is changing during the experiment, these times are not good parameters to control the lengths of forming droplets. Thus it's better to use visual feedback to control lengths of forming droplets. LabVIEW is an ideal environment for fully automatization of microfluidic experiments.

**Contact person:** Filip Dutka

**Time requirements:** 2 days, 12-16 hours

**Remarks:** Please contact me at least 2 weeks prior to the expected internship date.

---

## #112

**Title:** Basic microfluidic techniques

**Abstract:**

The goal of this laboratory internship is to (1) get familiar with the techniques used for fabrication of microfluidic chips, and (2) methods of generation single and double phase liquids flows what is more (3) detection methods perform in microfluidic chips.

**Contact person(s):** Michał Horka, Artur Ruszczak

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #113

**Title:** Transformation of E. coli with plasmid placEGFP coding GFP fluorescent protein.

**Abstract:**

The main goals of the course are: (1) familiarizing participants with traditional methods of bacteria culturing and (2) fundamental molecular techniques used in microbiology such as preparation of competent cells, isolation of plasmid DNA, and transformation of plasmid DNA. Moreover, the course provides an opportunity to work with GFP fluorescent protein commonly used in molecular biology.

**Contact person(s):** mgr Artur Ruszczak, dr Judyta Węgrzyn

**Time requirements:**

Day 1: Methods used for culturing of microorganisms, isolation of plasmid DNA (5h)

Day 2: Obtaining competent cells (5h)

Day 3: Transformation of bacteria (5h)

Day 4: Reading results (observing bacteria using confocal microscope) (2h)

The total number of hours: ~17h

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #121

**Title:**

Pomiar wielkości cząstek koloidalnych metodą dynamicznego rozpraszania światła (DLS) oraz ich potencjału Zeta.

**Abstract :**

Celem ćwiczenia jest (1) poznanie metody pomiaru rozmiaru cząstek koloidalnych z wykorzystaniem techniki dynamicznego rozpraszania światła. Student w czasie ćwiczeń może wykorzystać swój własny roztwór koloidalny albo użyć roztworu dostępnego w zespole 12. Kolejnym celem ćwiczenia jest (2) wyznaczenie potencjału zeta badanych cząstek koloidalnych.

**Contact person(s):** Michalina Iwan, Ewelina Kalwarczyk

**Time requirements:** 1 day; 4-6 hours

**Remarks:** Please contact any of the indicated persons at least 2 weeks prior to the expected internship date.

---

## #131

**Title:** Phase diagram of a hard spheres fluid

**Abstract:**

The goal of this laboratory internship is to (1) get familiar with the Monte Carlo simulations of simple fluids (2) calculate the phase diagram for the hard spheres fluid. The phase diagram will be obtained from the radial correlation function calculated for different densities.

**Contact person(s):** Paweł Rogowski, Jakub Pękalski

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #141

**Title:** Electrode reactions under hydrodynamic conditions.

**Abstract:**

The aim of the practical is (1) to learn how to do voltammetric measurements with a rotating disk electrode (RDE) and a rotating ring disk electrode (RRDE), and (2) to determine selected parameters of electrode reactions on the basis of the recorded voltammograms.

The electrode reactions of interest will be oxidation of ferrocyanide at RDE and reduction of oxygen at RRDE. Measurements will be performed with a potentiostat in a three-electrode cells. From the recorded voltammograms, students will determine number of electrons transferred during the reactions, diffusion coefficients of electroactive species, and the reaction yield.

**Contact person(s):** Martin Jönsson-Niedziółka, Magdalena Kundys

**Time requirements:** 2 days, 12 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---



## #142

**Title:** A practical introduction to scanning electron microscopy

**Abstract:**

The course will cover the basic modes of operation of SEM, sample preparation, x-ray spectroscopy and a description of the capabilities of our in-house microscope and other extended features. The course includes 4-5 hours of lectures and 4 hours of practical hands-on SEM imaging in small groups after which the students will be allowed to book and use the instrument on their own.

**Contact person:** Martin Jönsson-Niedziółka, tel. 3306.

**Time requirements:** as above

---

## #151

**Title:** Physisorption (ASAP 2020, Micromeritics) for determination of surface area, pore volume and pore size distribution

**Abstract:**

The goal of this laboratory internship is to:

1. get familiar with gas sorption techniques, applied to a wide variety of meso- and macropore materials (activated carbons and carbon black, pharmaceuticals, ceramics, nanotubes, catalysts etc.);
2. determination of a single- and multipoint BET (Brunauer, Emmett, and Teller) surface area at the temperature of liquid nitrogen;
3. determination of a pore volume and a pore area distributions in the mesopore and macropore ranges by the BJH (Barrett, Joyner, and Halenda) method.

**Contact person:** Dr Magdalena Bonarowska

**Time requirements:** 1-2 days, 8-10 hours

**Remarks:**

1. Please contact the indicated person at least 3 weeks prior to the expected internship.
  2. To eliminate the possibility of contamination of the instrument, all materials before an experiment should be heated in temperature at least 200°C.
-

## #152

**Title:** Chemisorption (ASAP 2020C, Micromeritics) for determination of metallic dispersion and active surface area

**Abstract:**

The goal of this laboratory internship is to:

1. get familiar with the static volumetric technique to determine the percent metal dispersion, active metal surface area and size of active particles;
2. determination of metal dispersion and active surface area from adsorption isotherms (using H<sub>2</sub> or CO) for a system “metal-on-support”.

**Contact person:** Dr Magdalena Bonarowska

**Time requirements:** 1-2 days, 8-10 hours

**Remarks:**

1. Please contact the indicated person at least 3 weeks prior to the expected internship
2. To eliminate the possibility of contamination of the instrument, all materials before an experiment should be heated in temperature at least 200°C

---

## #153

**Title:** The application of an electron capture detector (ECD) to analyzing the progress of catalytic purification of water from chloroorganic compounds

**Abstract:**

The main goal of the laboratory internship is to learn the method of operation of a gas chromatograph equipped with an electron capture detector (ECD) as a very sensitive tool for the analysis of chloroorganic compounds in water.

The exercise will include:

- preparation of the catalyst,
- catalytic reaction in liquid phase,
- monitoring of reaction progress by gas chromatograph equipped with the ECD detector

**Contact person(s):** Anna Śrębowata (☎3320), Izabela I. Kamińska (☎3360)

**Time requirements:** 8 hours in 2 days

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #161

**Title:** Prospective applications of Powder X-Ray Diffraction (PXRD) in (non)routine chemical and physical research.

**Abstract:** The Training is based on a complete characterisation procedure of a polycrystalline material:

- a) sample preparation,
- b) measurement setup and data acquisition,
- c) analysis and interpretation of results including crystal structure determination and its imperfections.

The main scope is to familiarise oneself with the fundamental applications Powder X-Ray Diffraction (PXRD) and to learn how to omit mistakes that affect the quality of the performed measurements and drawn conclusions.

**Contact person:** Maciej Zielinski ([mzielinski@ichf.edu.pl](mailto:mzielinski@ichf.edu.pl)) or Zbigniew Kaszukur ([zkaszukur@ichf.edu.pl](mailto:zkaszukur@ichf.edu.pl))

**Time requirements:** approx. 6 hours

**Remarks:** The training can involve the analysis of the trainee's crystalline powder sample. Please enrol 4 weeks before the estimated date of the training. The course is addressed to both individuals and small groups. Part of the software is freeware and one can perform the data analysis using his/her own computer.

---

## #171

**Title:** Application of mass spectrometry for the evolution of the chemical reaction

**Abstract:**

The following objectives of this laboratory internship are envisaged: (A) separation and structural elucidation of product(s) formed in the nitration reaction of selected aromatics ; (B) differentiation of positional isomers of selected molecules using capillary gas chromatography quadupole/ion-trap mass spectrometry.

**Contact person(s):** Paulina Wach ([pwach@ichf.edu.pl](mailto:pwach@ichf.edu.pl)), Dorota Staszek ([dorota.staszek83@gmail.com](mailto:dorota.staszek83@gmail.com))

**Time requirements:** one day, 5-6 h

**Remarks:** Please contact any of the indicated persons at least 3-4 weeks prior to the expected internship date.

---

## #181

**Title:**

Surface analysis of metallic materials by X-ray Photoelectron Spectroscopy (XPS)

**Abstract:**

The goal of this laboratory internship is to (1) understanding the phenomenon underlying the XPS method, (2) get familiar with the devices and operating conditions of the VG Microtech spectrometer, (3) measurement of XPS spectra for the metal chosen from Au, Fe, Ni, Mg, Zr (before and after Ar sputtering), (4) identification and quantification of surface elements.

**Contact person(s):** Tadeusz Zakroczymski, Arkadiusz Gajek

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 2 weeks prior to the expected internship date.

---

## #231

**Title:** Determination of heterogeneous reaction kinetics by scanning electrochemical microscopy

**Abstract:**

The goal of this laboratory internship is to get familiar with scanning electrochemical microscopy and procedure of determination of kinetic parameters of a model electron transfer heterogeneous process. Reaction rate constant and transfer coefficient will be determined by analysis of current-distance curves of the ultramicroelectrode approaching flat surface at which heterogeneous electron transfer process occur.

**Contact person(s):** Magdalena Kominiak, Wojciech Nogala

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 2 weeks prior to the expected internship date.

---

## #241

**Title:** Belousov-Zhabotinsky reaction; experiments and mathematical modelling.

**Abstract:**

The project is composed of two parts: experimental and numerical ones.

In the experimental part a student will prepare a medium for Belousov-Zhabotinsky reaction and will observe oscillations in a well stirred system and spontaneously appearing spatio-temporal structures.

Next he/she will study the oscillations in droplets containing reagents of Belousov-Zhabotinsky reaction surrounded by a solution of lipids in an organic phase and will establish a relationship between droplet volume and oscillation period.

The numerical part of the project will be concerned with simulations of oscillations and spatiotemporal structures based on simple reaction-diffusion models

**Contact person(s):** Jerzy Gorecki, Marian Gryciuk

**Time requirements:** 2 days, 6-8 hours per day

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #251

**Title:** Vibrational spectroscopy of hydrogen chloride

**Abstract:**

The goal of this laboratory internship is to (1) get familiar with the technique used for measuring highly resolved ro-vibrational infrared absorption spectra of gaseous samples, and (2) derive selected molecular parameters for hydrogen chloride, based on the detailed analysis of obtained FTIR spectra.

**Contact person(s):** Thomas Custer

**Time requirements:** 1 day, 6-8 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #281

**Title:** Photocatalytic methods for water/air purification

**Abstract:**

The goal of this laboratory internship is to (1) get familiar with the use of photocatalysts for the oxidation of organic molecules in liquid and gas environments, and (2) use analytical methods such as High Performance Liquid Chromatography (HPLC) and Gas phase Chromatography (GC) during the monitoring of reaction products.

**Contact person(s):** Juan Carlos Colmenares, Agnieszka Magdziarz.

**Time requirements:** approx. 2-4 days, 10 -15 hours

**Remarks:** Please contact any of the indicated persons at least 4 weeks prior to the expected internship date.

---

## #291

**Title:** Elektronowe widma absorpcji, emisji i wzbudzenia.

**Abstract:**

Przedmiotem ćwiczenia jest rejestracja widm absorpcji i fluorescencji wybranego chromoforu w roztworze w temperaturze pokojowej, a następnie wykonanie widma wzbudzenia emisji i porównanie go z widmem absorpcji. Szczególny nacisk położony zostanie na zrozumienie warunków potrzebnych do poprawnego zmierzenia widm emisji i wzbudzenia.

**Contact person(s):** Jacek Waluk, Maria Pszona, Krzysztof Nawara, Natalia Masiera

**Time requirements:** approx. 1 day; 6-8 hours

**Remarks:** Please contact any of the indicated persons approx. 2 weeks prior to the expected internship date.

---

## #311

**Title:** Simulations of chemical reactions at small numbers of molecules

**Abstract:**

The goal of this laboratory internship is to check how the kinetics of chosen chemical reactions changes depending on the number of molecules. At small numbers of molecules, there occur large fluctuations in concentrations, while at large molecule numbers the fluctuations are negligible. Standard equations of chemical kinetics describe, by definition, mean concentrations and therefore are valid for large numbers of molecules. When the reaction takes place at very low concentrations (eg. in the interior of living cells, where the reactants are often present in quantities of 1, 10, 100 per cell), the equations of chemical kinetics may give incorrect results. The exercise will consist of: 1) Simulation of the reaction system with a ready-to-use computer program using Gillespie algorithm (simulation of the reactions of single molecules a random process); 2) Numerical solution of equations of chemical kinetics using symbolic algebra software; 3) Comparison of both the results to check whether the concentrations calculated using the two methods agree, and if not, how big is the error resulting from the fact that the standard deterministic rate equations do not take into account the randomness of chemical reactions.

**Contact person(s):** Jakub Jędrak, [jjedrak@ichf.edu.pl](mailto:jjedrak@ichf.edu.pl)

**Time requirements:** 1 day, 4 hours

**Remarks:** The student should be at least a little bit familiar with the Linux operating system and symbolic algebra programs such as Maple or Mathematica.