PROPOSTA DIDATTICA 2017/2018

Radiochemistry and flow reactions

Dr. Giancarlo Pascali (ANSTO: Australian Nuclear Science and Technology Organization, AUS)

Nuclear Medicine imaging allows to gain valuable insights of the specific biochemical mechanism underlying several diseases. It relies on the injection of molecular vectors (e.g. drugs, peptides, nanoparticles) radiolabelled with selected radioisotopes; these vectors are then localized and quantified using sensitive tomographic instruments. The availability of suitably radiolabelled vectors is indeed the key to investigate known and new biochemical mechanisms, and it strongly relies on the capacity of the radiochemist to introduce selectively the needed radioisotopes in relevant molecular contexts.

This course will provide the basis to familiarize with employed radioisotopes and their features, and to understand the current radiolabelling processes, with a particular focus on the use of short-lived isotopes. Some important radiopharmaceuticals will be used to exemplify the overall workflow, from production to imaging. New approaches and radiolabelling reactions will be shown, as well the current challenges. The use of automation and the impact of flow chemistry will be demonstrated; an introduction to the general regulatory framework for the clinical use of these molecules will also be given.

Electrochemistry and spectroelectrochemistry of bioactive compounds

Prof. Romana Sokolova (J. Heyrovsky Institute of Physical Chemistry, Czech Academy of Sciences)

Introduction to molecular electrochemistry: oxidation and reduction mechanisms. Applications to the determination of redox mechanism of bioactive compounds. Chemical reactions coupled to the electron transfer – preceeding, following, parallel chemical reactions, catalysis. How to recognize processes in the adsorbed state? Examples of oxidation of bioactive compounds

Electronic circular dichroism and supramolecular Chirality

Prof. Gennaro Pescitelli

The course aims to furnish the basic knowledge of electronic circular dichroism spectroscopy and present extensively its application to the study of chiral supramolecular systems. The course is organized into three units covering the following topics: (1) basic introduction to electronic circular dichroism (ECD) spectroscopy; (2) supramolecular chemistry, with special attention to natural and artificial chiral supramolecular systems; (3) ECD as a privileged means to study chiral supramolecular systems: detection, quantification, assessment of supramolecular helicity, structure determination.

Fast reaction techniques

Dr. Tarita Biver

Stopped-flow and temperature jump approaches will be mainly taken into account, together with some hint on pressure jump, electric field jump and single molecule fluorescence

spectroscopy (FCS).
The strong points and limits of the techniques, the practical aspects to be considered for the design of the experiments and some examples on the study of the equilibria of chemical systems will be discussed.

Advanced organic chemistry for complex systems

Dr. Gaetano Angelici

The course is structured in three main parts. A first introduction to combinatorial chemistry, multicomponent reactions and encoding strategies, followed by a more applicative overview on Dynamic Combinatorial chemistry for drug discovery. Finally, we will analyze the field of Systems chemistry and it's relation with chemical evolution and molecular network interactions.

Modification and property control of polymer blends and composites

Prof. Mariano Pracella

Phase behavior of multicomponent polymeric systems. Morphological and structural aspects. Crystallization processes and thermal, rheological and mechanical properties. Compatibilization of heterogeneous systems: functional modification and reactive mixing processes. Polymeric mixtures with liquid-crystalline components. Recycling of packaging plastics. Polymeric composites reinforced with natural fibers. Biodegradable nanocomposites containing cellulose nanocrystals.

Paramagnetic NMR

Lorenzo Di Bari

Paramagnetic ions introduce special features in NMR spectra, which make them poorly readable with standard interpretation methods. However, very often one can obtain extremely valuable information, by means of simple experiments and relatively easy concepts. The basic principles of the effect of paramagnetism on the chemical shifts and on nuclear relaxation will be treated in a very simplified and accessible way, with special emphasis on f-metals, which allow for high resolution structures in solution.

Electron microscopy: detection, characterisation and quantification of nanomaterials (part I & II)

Josefina Pérez-Arantegui

From 2006, it raised serious concerns about the potential risks of the nanotechonology and engineered nanomaterials (ENMs) in relation to the human health and the environment. The challenge for the analytical scientists is to develop innovative approaches to detect, characterized and quantified ENMs in complex samples, at realistic concentrations and in the presence of natural particles, of similar or different nature. Electron Microscopy has been the most powerful technique to detect nanomaterials because of its good spatial resolution, and

then an efficient tool to characterise ENMs. Among the different microscopic techniques, conventional Transmission Electron Microscopy (TEM) accomplishes most of the requirements proposed for the characterisation of ENMs in complex matrixes. Additionally, the introduction of field-emission electron guns in most of the current Scanning Electron Microscopes (Field-Emission Scanning Electron Microscopy, FESEM) has allowed the successful use of these instruments for ENM characterisation due to the better spatial resolution (bellow 1 nm) generated by this type of electron sources.

Hyperspectral imaging: suitability of the reflectance spectra to identify materials in artworks

Josefina Pérez-Arantegui

In recent years, research carried out mostly on paintings has proved that imaging spectroscopy techniques can be effectively used for material identification and mapping on works of art. “Hyperspectral imaging” can be considered as the combination of digital imaging with reflectance spectroscopy. Regarding the analysis of pigments, the hyperspectral imaging provides the associated reflectance spectrum for every point of the image, which can be compared with those of a reference database. Spectral imaging systems provide a powerful tool for non-invasive, non-contact identification and characterization of pigments, inks, substrates and treatments of artefacts, allowing completely non-destructive analyses for research and preservation of artworks.

What happens at the interface, does not stay at the interface. Interfacial science meet polymer chemistry

Dr. Patrizio Raffa - *University of Groningen, Faculty of Science and Engineering ENTEG Institute Product Technology - Chemical Engineering Nijenborgh 4, 9747 AG Groningen, The Netherlands*

Interfaces are of fundamental importance in many aspects of life: the properties of several complex systems, from composite materials to living organisms, are often determined by the presence of a non-negligible interface between different phases. Polymers, in particular amphiphilic ones, nowadays play a relevant role in interfacial science, specifically in the design of technologically advanced products (flooding agents for enhanced oil recovery, drug delivery systems, responsive materials, etc). In this cycle of lectures, after a general introduction to the fundaments of interfacial science, the role of polymer chemistry in this domain will be explored. Particular emphasis will be given to the synthesis and properties of amphiphilic polymers and some of their applications in solution. Solid-solid interfaces in “smart” composite materials, with some example of recent research, will be also illustrated.