X-ray imaging and tomography: recent advances and challenges

Andrea Somogyi

[1]*Synchrotron Soleil, St-Aubin, France*

State of the art X-ray imaging and tomography techniques provide access to the study of heterogeneous, complex systems with high elemental and structural sensitivity. During recent years the significant progress of instrumentation (focusing optics, sample positioning and cooling, detector technology) and X-ray imaging methodologies (e.g. coherent imaging) are triggering experimental approaches with deca-nanometer spatial resolution. Trace metals play important roles both in biology (e.g. normal and in disease-causing biological functions) and in material sciences (e.g. dopants, impurities and their effects on material properties and device functioning). X-ray fluorescence microscopy reveals trace elements with improved sensitivity relative to electron probes. Its combination with complementary X-ray techniques offers a way to study trace elements in their structural context.
The large penetration depth of hard X-rays makes the study of tissue sections, whole cells, layered/buried structures possible also in *in situ* and *in operando* conditions. Complex sample environments (temperature, pressure, controlled atmosphere/vacuum, chemical environment) are possible to implement. One of the important issues in modern microscopy development is the combination of high resolution with imaging in three dimensions, since the 3D nanostructure of a specimen has basic influence on its biological, chemical and physical properties. This presentation aims to provide a brief overview of the recent advances and challenges of these imaging techniques.