**Use of large-scale research facilities for material science: from basics to recent development trends in Europe**

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'Large-scale research facilities' is a common name typically used nowadays for describing synchrotrons and neutron sources as well as free-electron lasers and other particle accelerators. Over the last decade, such facilities have been rapidly transforming from use by a limited group of dedicated physicists to the main-stream tool facilitating accelerated development of science and technologies in every field of our activities. For example, Japan operates a synchrotron 'Spring-8' and a neutron scattering facility at 'J-PARC', while around the World open user programs have 23 synchrotrons and 18 neutron sources including 13 and 8 such facilities, respectively, in Europe. Sweden with a central location in Lund has been emerging as a 'hot spot' in this space opening a synchrotron MAX IV Laboratory (MAX IV) in 2016, and a most powerful in the World neutron science facility European Spallation Source ERIC (ESS) scheduled to open for users in 2025.

The large-scale research facilities can be viewed as a natural development of still more common laboratory-scale analytical tools. They can be traced from the development of a first optical compound microscope "Micrographia" in late 17$^{th}$ century where optical lenses were used for condensing photons in a visible spectrum; to electron microscopes where electro-magnetic lenses are used to accelerate electrons, still in a laboratory-scale environment predominantly; to latest facilities where particles that can be charged, e.g. electrons or protons, are accelerated for use as a scattering source generating x-rays, neutrons, *etc.* in a wide range of frequency spectra. Scattering particles are then utilised at beamlines, sometimes having several end stations, for an extremely diverse range of experimental techniques elaborated in the research community by now. One of the strongest sides of such facilities compared to laboratory-scale counterparts is the possibility of setting up experiments in *in situ* and *operando* conditions with very high temporal resolution. These open exceptional opportunities for new discoveries in material science including heterogeneous materials with micro-architected structures.

Nevertheless, it might appear difficult to navigate the environment of large-scale research facilities for material scientists without appropriate background in respective characterisation techniques. Therefore, this talk will clarify similarities, differences and complementarities between laboratory- and large- scale research facility based techniques for materials characterisation. Perspectives on light property control enabled by large-scale facilities as well as brief overview of modern methods of highest interest for crystalline materials including *in situ* techniques will also be given. These will be illustrated by the analysis of hetero-structured materials with examples from our experiments on harmonic-structured pure nickel. Recent trends in the development of characterisation techniques and large-scale research facilities themselves in Europe will also be overviewed.