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Observing Nanomaterials in Action Using Synchrotron Radiation

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Exactly 15 years ago, in September 2007, the beamline MCX (Material Characterisation by X-ray diffraction) was officially inaugurated at the Italian synchrotron facility, Elettra – Sincrotrone Trieste. The powder diffraction beamline was designed to study nanostructured materials, investigating details of crystalline domain size and shape, lattice defects, and local atomic displacement of static and dynamic nature using Line Profile Analysis (LPA) [1]. However, the flexible set-up of the experimental station [2] allows for a wide variety of diffraction experiments in different fields ranging from phase identification in cultural heritage to operando battery studies in energy research, and from residual stress analysis in engineering to structure determination of new pharmaceuticals. Furthermore, the beamline is equipped with a specially designed furnace that allows to perform temperature dependent studies under controlled conditions [3].
Thanks to this flexible experimental set-up, MCX has not only hosted experiments to fully characterize nanostructured materials, but has also been the place to study these type of materials in action. Here, some recent results obtained at the beamline from these *in situ* and *operando* studies will be presented. These include the structural evolution of nanostructured materials, chemical reactions inside nanoparticles and the effect of nanostructures on catalytic reactions and battery performance.
Currently, within the scheme of the upgrade of Elettra, MCX is preparing for a major upgrade of the beamline. This will already start in 2023 with the installation of a brand new 3-circle diffractometer with a Mythen-II detector covering 120° 2Θ. This upgrade will have a major impact on the type of experiments addressed here. Therefore, also the future prospects for studying nanostructured materials in action will be discussed.

[1] L. Rebuffi, J.R. Plaisier, M. Abdellatief, A. Lausi, P. Scardi, Zeitschrift fur Anorganische und Allgemeine Chemie 2014, 640, 3100.
[2] J.R. Plaisier, L. Nodari, L. Gigli, E.P. Rebollo San Miguel, R. Bertoncello, A. Lausi, ACTA IMEKO 2017, 6, 71.
[3] P. Riello, A. Lausi, J. MacLeod, J.R. Plaisier, G. Zerauschek, P. Fornasiero, Journal of Synchrotron Radiation 2013, 20, 194.

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