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Microscopic insights on properties of morphologically complex materials using advanced synchrotron-based methods

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The invent complex nano-structured and composite materials with improved structural, chemical, electric, magnetic and optical properties has pushed the development and implementation of appropriate characterization methods exploring their structure, dynamics and function at proper spatial, temporal and energy scales. In this respect the complementary capabilities in terms of imaging, spectroscopy, spatial and time resolution of the tools operated at 3rd and 4th generation synchrotron facilities have opened unique opportunities to explore the properties of complex functional materials as a function of their size, morphology, composition and operation conditions. Ongoing developments are pushing the lateral and temporal resolution and set-ups allowing for in-situ measurements under realistic operational conditions. The most recent achievements will be illustrated by using selected results from studies of the properties of technologically relevant multicomponent materials following the effects of the chemical ambient, temperature, electomagnetic fields and radiation. The talk will include (i) properties of free-standing nanostructures as a function of composition, dimensions and ambient [1, 2]; (ii) variations in morphology and chemical state of key functional constituents in electrochemical devices as a function of growth or operating conditions [3-5]; (iii) tracking the ultrafast dynamics triggered by external stimuli with access to elemental and/or magnetic structure of the specimen [6].
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[6] F. Bencivenga et al, Adv. in Physics 63 (2014) 327.

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