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3D Electron Diffraction for nanocrystalline materials

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Introduction, prof. **Piero Macchi** (Politecnico di Milano, DCMIC)

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In the last decade, crystallography of nanocrystalline materials has witnessed a tremendous growth thanks to technological innovations and methodological developments in the field of electron diffraction. Nowadays it is possible to obtain single-crystal 3D diffraction data from crystalline materials sized from few microns down to several tens of nanometres, and thus solve their crystal structure [1]. Electron diffraction can allow us to understand the structure and function of matter down to a scale where single-crystal x-ray diffraction is not applicable and powder diffraction methods are extremely challenging, for instance in case of large unit cells, low symmetry, severe peak broadening and, not least, in mixture of phases.
Electron diffraction, implemented in a TEM or in newly designed electron diffractometer, has become a useful tool for the characterization of materials that are nanocrystalline by design or by contingency. In this talk, an overview of the technique will be given, with its strengths and limits. Some examples will be presented, in which electron diffraction alone or in combination with other techniques enabled the solution of complex crystallographic puzzles, thus emerging as the method of choice for the investigation of materials obtained by innovative synthetic and crystallization methods, such as mechanochemistry [2], supercritical fluid synthesis [3] and crystallization from deep eutomic solutions [4].

[1] M. Gemmi et al. ACS Cent. Sci. 2019, 5, 8, 1315-1329.
[2] A. Lanza et al. 32nd European Crystallographic Meeting, 2019, MS33-P10.
[3] N. Portolés-Gil et al. ACS Sustainable Chem. Eng. 2018, 6, 9, 12309-12319.
[4] V. Hamilton et al. Cryst. Growth Des. 2020, 20, 7, 4731–4739.

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