ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

High-resolution diffraction at the Swedish high-energy materials science beamline P21.2

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It has been demonstrated that high-energy synchrotron radiation is a powerful tool for the structural characterization of polycrystalline bulk materials during thermo-mechanical processing. Pertinent features are high penetration power and high spatial and temporal resolution. We will discuss the potential of combining these features with high reciprocal space resolution, as implemented at the Swedish high-energy materials science beamline P21.2 at the PETRA III synchrotron facility. Critical instrumentation includes a narrow bandwidth monochromator, focusing optics, and area detectors with several tens of Mega-pixels. Two limiting sample configurations will be discussed: (i) powder-like samples where numerous grains diffracts simultaneously, resulting in continuous diffraction rings, and (ii) grain resolved diffraction where spots from individual grains can be isolated on the diffraction rings. The grain resolved diffraction provides radial and azimuthal profiles on the cost of the statistical significance of the observed number of grains. Different methodologies will be illustrated by case studies. Finally, novel opportunities arising from the ongoing upgrades of synchrotron facilities towards dramatically reduced emittance will be discussed briefly.

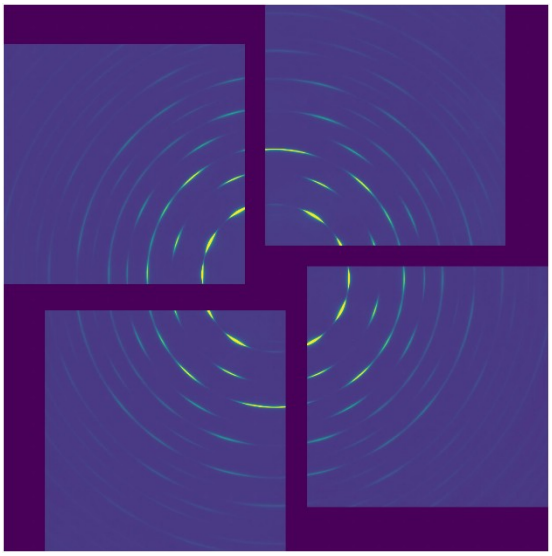

Fig.1 Diffraction image of a strongly textured electrodeposited Fe-C layer recorded with four flat-panel detectors, resulting in approx. 33-megapixel total detector area.

Keywords: High-energy synchrotron radiation, polycrystalline bulk materials, thermo-mechanical processing, high-resolution diffraction