OBSERVATION OF HIGH-RESOLUTION DIFFRACTION PROFILES FROM SINGLE GRAINS WITHIN POLYCRYSTALLINE METALS*

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Understanding the behavior of polycrystalline materials on the grain and subgrain length scale under thermomechanical processing is still limited. A major cause of this deficiency has been the lack of experimental techniques that provide (i) *in-situ* observation on the grain-size length scale (rather than averaging over many grains), and (ii) bulk information (the surface behavior is not representative due to strain relaxation, abnormal grain growth, etc). Recently, it has been shown that diffraction of focused high-energy synchrotron radiation (40-90 keV) in combination with 2-dimensional detectors fills this gap.[1,2] However, so far only broad-band incident x-ray beams have been used which do not allow for extraction of the intrinsic peak profile that should be related to the sub-grain structure. Here, we will report on experiments using narrow bandwidth high-energy synchrotron radiation.

The experiments are performed at the 1-ID-C station of the Advanced Photon Source (APS) at the Argonne National Laboratory on Al and Cu samples under tensional deformation. Key experimental techniques are exclusion of diffracting grains that are too close to the sample surfaces, determination of the complete grain orientation (as given by three Euler angles), and the (fast) acquisition of diffraction peak profiles with a momentum resolution of $q/\Delta q = \tan\theta/\Delta\theta \approx 10^4$.

Feasibility studies have been performed at 40 keV on high-purity Cu samples with an initial average grain size of 30 µm. The maximum deformation was 20%. It has been demonstrated that the 2-dimensional detector, which was positioned 3 m behind the sample, provides high-resolution 2θ profiles and at the same time a mapping of the sub-grain mosaic spread around an axis parallel to the incident beam. The mosaic spread around an axis perpendicular to the diffraction plane is mapped by sample rotation.

An upcoming experiment is aimed at the investigation of grain-grain interactions and at establishing a more systematic methodology for representing the grain mosaicity by means of orientation distribution functions.

[1]Lauridsen E.M., Schmidt S., Suter R.M., Poulsen H.F., J. Appl. Cryst., **34**, 2001, p. 744
[2]Poulsen H.F., Nielsen S.F., Lauridsen E.M., Schmidt S., Suter R.M., Lienert U., Margulies L., Lorentzen T., and Juul Jensen D., J. Appl. Cryst., **34**, 2001, p. 751

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