March Meeting of the American Physical Society
March 3-7, 2003
Austin, TX

X-ray Laue Microdiffraction Studies of 3-D Grain Growth in Bulk Aluminum

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Our understanding of grain growth in bulk polycrystalline materials has been limited by the absence of experimental 3-D measurements of grain sizes, shapes and orientations. We have developed a nondestructive microscopy technique with submicron 3-D point-to-point spatial resolution using focused, white x-ray microbeams at the Advanced Photon Source (Larson et al, Nature, 2002). Measurements of the grain microstructure have been obtained for polycrystalline aluminum (1\% Fe, Si) hot-rolled at 200°C. The 3-D grain orientation mapping shows typical grain sizes up to about 10 microns. Hot-rolling induces (001) texture, but both high-angle and low-angle grain boundaries are observed. Small second phase precipitates have also been located. The sample was subsequently annealed above 300°C, resulting in the movement of particular grain boundaries and the consumption of certain grains. The experimental 3-D thermal grain growth results will be discussed in terms of theoretical models of microstructural evolution.

Sponsored by U.S. DOE under contract DE-AC05-00OR22725 with UT-Battelle, LLC. Work performed on UNICAT beamline at the APS which is also supported by DOE.