In Situ-Grain Boundary Velocity Measurements in High Purity-Zinc

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Introduction

Experiments with a space-resolving high magnetic field polarization microscopy probe were conducted. With this high field probe it is possible to track the evolution of position and shape of a grain boundary at the surface of magnetically anisotropic, crystalline materials [1].

Experimental Procedure and Results

The probe consists of an incident light polarizing microscope with a CCD camera aligned in field direction over a sample chamber. While a high magnetic field is applied, the sample temperature is increased stepwise in an inert gas atmosphere. Several microscope settings are remote controlled either by stepper motors or manually.

Samples of 99.999% pure Zinc had been annealed under perpendicular alignment of the sample axis to the magnetic field. The sample's c-axis was aligned parallel to the field. Due to plastic deformation prior to the magnetic annealing, new grains grew *in situ* with crystallographic orientation perpendicular to the magnetic field, which is caused by different magnetic susceptibilities parallel and perpendicular to the c-axis. The grains with c-axis perpendicular to the field are energetically favored, which allows the one grain with c-axis closest to perpendicular orientation to prevail and grow over the entire sample cross section, consuming the initial grain orientation in the progress [2].

In the experiments conducted in February 2007 in most cases the moving boundaries could not be detected due to a lack of contrast, which was caused by failing to adjust the contrast to visualize new grown grains while still in field of view. Therefore, the migration of individual boundaries could not be measured systematically.

Orientation measurements after the experiments showed, that in fact magnetically induced grain boundary motion had occurred in most samples. For the majority of samples, a boundary with an angle of inclination between 80°-90° and a rotational axis <10-10> was found to have migrated through the sample, which can be explained by the fact that on those boundaries the maximum driving force is exerted. Therefore, in future trials the experimental focus will be set on using specially grown bicrystals containing exactly those grain boundaries as samples. Furthermore, the probe has recently been modified with Ag-based nano-particle Codixx® polarization filters that ensure superior contrast and further increase the *in situ*-visibility of migrating grain boundaries. Both of these measures will simplify the experimental procedure, as contrast may then be adjusted to visualize grain boundaries before they become mobile, prior to the actual experiment. Therefore, the boundaries will not escape the field of view undetected, as it had often been the case with in situ-grown bicrystals during last session.

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References

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