熊本大学自然科学系国際共同研究拠点主催 特別講演会

今回の特別講演会は、材料科学分野，特に粒界移動現象や再結晶の分野において世界的に著名な研究者であるアーヘン工科大学の Dmitri Molodov 教授に「粒界ダイナミックス」に関する最近の話題をご提供頂きます。

講　師：**Prof. Dmitri A. Molodov**

(Institute of Physical Metallurgy and Physics, RWTH Aachen University)

講演題目：**Recent investigations into dynamics of grain boundaries in metals**

日　時：平２６年２月２７日（金）　１４時３０分～１６時００分

会　場：熊本大学工学部研究棟Ｉ ３階　３０８教室

要　旨：

The current research on grain boundary dynamics in metals will be reviewed. Modern techniques for investigation of grain boundary motion in bicrystals - on-line measurements based on X-ray diffraction, in-situ observations utilizing the orientation contrast of adjacent grains by back scattered electrons in a scanning electron microscope (SEM) or due to the anisotropy of reflectivity of visible light, will be presented.

The in-situ technique in a SEM was recently utilized for investigation of the migration and faceting behavior of <100> and <111> tilt low angle grain boundaries and boundaries with misorientations in the transition range from low to high angles. The results revealed that boundaries with misorientation $\theta<15°$ did not attain a continuously curved shape in the entire temperature range up to the melting point and, thus, did not move under a capillary driving force. Instead, they remained straight or formed several facets which were inclined to the initial boundary orientation. In contrast to pure tilt boundaries, the mixed boundaries were found to readily assume a curved shape and steadily move under the capillary driving force. Molecular statics simulations suggest that the observed behavior of low angle boundaries is due to the anisotropy of grain boundary energy with respect to boundary inclination. This anisotropy diminishes with increasing misorientation angle for pure tilt boundaries as well as with the change of the geometry of low angle boundaries from pure tilt to mixed such that high angle tilt and low angle mixed boundaries can assume a continuously curved shape and move under the curvature driving force.

The migration of grain boundaries in Al was also measured under the applied mechanical stress. Both small and large angle symmetrical <100> tilt grain boundaries in the entire misorientation range (0° - 90°) were examined. Boundary migration under a shear stress was observed to be ideally coupled to the lateral translation of grains. This coupling proved to be the typical migration mode of any <100> tilt boundary, no matter whether low- or high angle, low Σ CSL coincidence or non-coincidence boundary. The measured ratios of the normal boundary motion to the tangential displacement of the grains were in an excellent agreement with theoretical predictions.

Grain boundary motion can be induced by a magnetic field, if the anisotropy of the magnetic susceptibility generates a gradient of the magnetic free energy. In contrast to curvature driven boundary motion, a magnetic driving force also acts on planar boundaries so that the motion of crystallographically well-defined boundaries can be investigated, and the true grain boundary mobility can be determined. The results of migration measurements obtained on Bi and Zn bicrystals will be addressed.

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