Defect and Diffusion Forum Vols. 194-199 (2001) pp. 1253-1258
online at http://www.scientific.net

The Kinetics and Thermodynamics of Deformation Twin Grain Boundaries in Zn

A.U. Tuflin[1,3], V.G. Sursaeva[1] and U. Czubayko[2]

[1] Institute of Solid State Physics, Russian Academy of Sciences, RU-142432 Chernogolovka, Moscow District, Russia

[2] Hahn-Meitner-Institut Berlin GmbH, Glienicker Strasse 100, DE-14109 Berlin, Germany

[3] Moscow Engineering Physics Institute, 31 Kashirskoe Sh., Moscow 115409, Russia

Keywords: Coherent(Incoherent) Grain Boundary, Enthalpy of Activation, Grain Boundary, Mobility

Abstract. The paper presents experimental data on the motion of incoherent grain boundaries in Zn. The twin grain boundaries in Zn can be envisioned as the $[11\bar{2}0]$ tilt grain boundaries with angle of misorientation 86°. The surface of coherent twin boundaries in Zn is $(01\bar{1}2)$. The mobility of incoherent twin boundaries in Zn of different purity by observation *in situ* was measured. It was found that kinetic parameters of incoherent grain boundaries are varied through a definite range. The activation and activation-less motion of incoherent boundaries were observed. The surface tension of coherent grain boundary was estimated. Namely, the estimation gives that surface tension of coherent grain boundary approximately in three order of magnitude smaller than this one for high-angle grain boundary.

Introduction

As known there are deformation twins and annealing twins. The annealing twins are the main structural defects of polycrystals with low and medium stacking fault energy. The deformation twins are the main structural defects of deformed polycrystals. What all the nodules have in common is that they have the same correlation "matrix/twin".

Twinning mechanism is an important mode of deformation in hcp metals. Atomic structure of twins was investigated much better than the kinetic and thermodynamic parameters of them, in particular the mobility and energy of coherent and incoherent twin grain boundaries. Deformation twins increase by the motion of twinning dislocations along the twin-matrix interface, while shrinkage of them is going by incoherent twin grain boundary motion along coherent twin grain boundaries during annealing under high temperature. The elements of the twinning mode are $K_1=(10\bar{1}2)$ and $\mu_1=[10\bar{1}\,\bar{1}]$. The twin grain boundary we can describe in terms of axis and angle as grain boundary generated by rotation 86° about axis $[11\bar{2}0]$. The main aim of the undertaken investigation was to measure by observation *in situ* the mobility of incoherent twin boundaries in Zn of different purity (99.995 at. % and 99. 9995 at. %) in a relatively wide temperature range (275 - 410 °C) and to estimate the surface energy of incoherent twin grain boundaries.

Experimental Procedure

The study of the mobility of incoherent twin grain boundary was carried out on zinc bicrystals (the direction $[11\bar{2}0]$ is perpendicular to the surface of the samples, Fig.1). Single crystals of Zn were grown by directional crystallisation technique, using high purity (99.995 at. % and 99,9995 at. %) zinc. By means of an applied stress, deformation twins were introduced into the single crystal [6] and a bicrystal having the shape of half a loop is obtained with two coherent and one incoherent grain boundaries. Due to the noticeable difference of surface tension between coherent and incoherent