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Diffusion of Au along <100> Symmetrical Tilt Boundaries in Copper: Grain-Boundary Roughening?

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Abstract. Recently the diffusion of Au in copper in <100> symmetrical tilt grain boundaries (*GBs*) in the narrow misorientation range around Σ5(310) coincidence GB (*Budke et al. 1998, 1999*) was investigated. This study gives strong suggestion for GB phase transformation through entire misorientation range examined. It is shown that this is an intrinsic structure transformation at the GBs in copper. This transformation is supposed to be a GB roughening. The roughening destroys CSL-related superstructure, and thus, transforms near-coincidence GBs to general GBs. The roughening of general GBs leads likely to the formation of two-dimensional liquid-like layer.

Introduction

Recently the results of the study of diffusion Au along <100> symmetrical tilt grain boundaries (*GBs*) in copper nearby Σ5(310) coincidence GBs were published [1, 2]. One of the most interesting results is a non-linearity of the Arrhenius dependences of *the GB diffusion parameter*[1] P^{Au} over entire studied range of misorientation angles Θ. The superscript *Au* denotes the diffusant. It has been shown that the non-linearity is likely due to a discontinuity of the dependences [2]. Such a behaviour suggests a GB phase transformation [4]. However, the consideration in details of this matter was beyond the scope of [1, 2]. In the present paper an attempt is undertaken to fill this gap. Also probable nature of the GB phase transformation is considered. It is shown that data obtained in [1, 2] can be explained in the assumption that this transformation is the GB roughening. Also the effect of GB structure on the GB roughening is discussed.

The facts indicating on the GB transformation

Non-linearity of Arrhenius plots. In Fig. 1 the Arrhenius plots of P^{Au} are presented. They

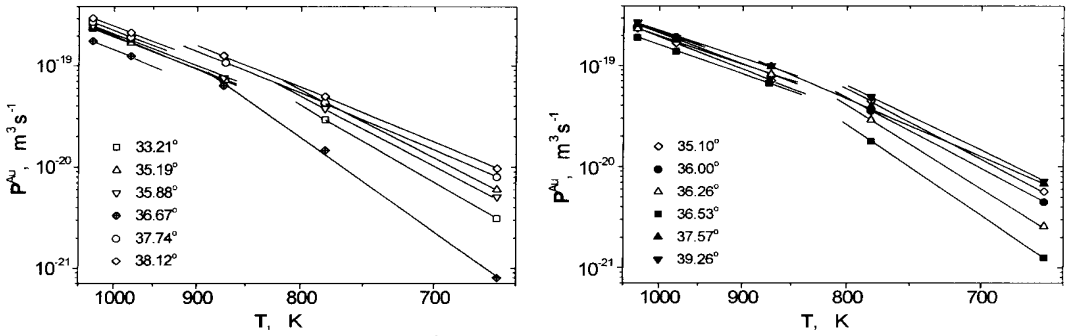

Fig. 1. Arrhenius dependences of the P^{Au}. The contribution of the twist component is excluded [2].

[1] $P = s\delta D$, where s is the GB segregation factor, δ is the diffusional width of grain boundary and D is the GB diffusion coefficient [3].