Ultrasonic Studies on Aluminum Bicrystals

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Introduction

Bicrystals are the perfect objects for studying of solids’ boundaries. Thus, knowing characteristics of the crystalline on the both sides of the boundary the attributes of the boundary itself might be possible to extract from the experimental data. Additionally, magnetic field applied at specific orientations changes the boundary properties for it varies characteristics of each monocristalline differently due to anisotropy. Aluminum bicrystals were selected for these studies due to the known properties, e.g., Fermi surface, of the monocristalline aluminum, therefore allowing the calculation of the magnetic field affect on each crystalline.

Experimental

Propagation of ultrasound waves through an aluminum bicrystal was studied. Experiments were performed in magnetic fields of up to 18T in the temperature range 0.3-1.6K (SCM2 system) at frequencies 30-150MHz. A quasilongitudinal ultrasound wave propagated in direction perpendicular to the bicrystal boundary. The sample was rotated in the magnetic field to determine its positions where the difference in the crystalline properties is at maximum.

Results and Discussion

Acoustic quantum phenomena were observed on magnetic field dependencies of ultrasound attenuation (Fig. 1 (a)) and velocity (not shown). Angle dependencies of ultrasound velocity (not shown) and attenuation (Fig. 1 (b)) reveal extrema when the magnetic field is parallel to the bicrystal boundary or crystallographic direction (100) in one of the crystalline. While the experiemnts in magnetic field allow seeing individual features of each aluminum monocristalline, more detailed analysis should be performed to identify magnetic field effects on the boundary of the aluminum bicrystal.

Figure 1. (a) Magnetic field and (b) angle dependence of the ultrasound attenuation in aluminum bicrystal, where the subscripts I and II relate to two different crystallines.

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