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Ultrasonic Measurements of Interaction between Dislocations and Point Imperfections*

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The measurements of the resonance damping of dislocations permits the possibility of determining the free loop length of the vibrating dislocation strings. Point imperfections created by radiation damage, plastic deformation or quenching, are able to migrate to the dislocations, and to act there as additional pinning points. This leads to a reduction of the free loop length so that it becomes possible to study the production and migration of the point imperfections by measuring the time dependence of the dislocation damping.

Results of such measurements will be described and discussed.

COMMENT

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Ultrasonic Attenuation of Aluminum Single Crystal

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The objective of our study is to investigate about the dynamic behavior of dislocations in high purity aluminum single crystal which is annealed or slightly cold worked. High purity aluminum which contains 0.0005% silicon, 0.0006% iron and 0.0010% copper was used. A single crystal (20 mm in diameter) was prepared by Bridgemann method with reactor grade graphite crucible. The single crystal was cut into specimens of 15 mm length, and then annealed at 500°C for 1 hr in vacuum of 10^{-5} mm Hg and electrolytically polished. Its orientation is shown in Fig. 1. The dislocation density, obtained from etch pits on the plane perpendicular to {111} and parallel to <011> by Lacomb's solution, is 6.3 $\times 10^5$ lines/cm^2.

Quartz (of X-cut, 6 mm in diameter) was attatched to the specimen with "Sarol" and then ultrasonic attenuation was measured. The apparatus, for the measurement is "Ultrasonic Comparator" of Sperry's Products, the frequency range of which is from 5 Mc/s to 200 Mc/s.

In the case of annealed crystal the result of frequency dependence of attenuation is shown in Fig. 1, curve 1. The measured decrement decreases with frequency and shows minimum and then gradually increases. After 0.63% cold working in compression, the time dependence of attenuation was measured within the range from 5 Mc/s to 55 Mc/s. The value at 35 Mc/s is plotted in Fig. 2.

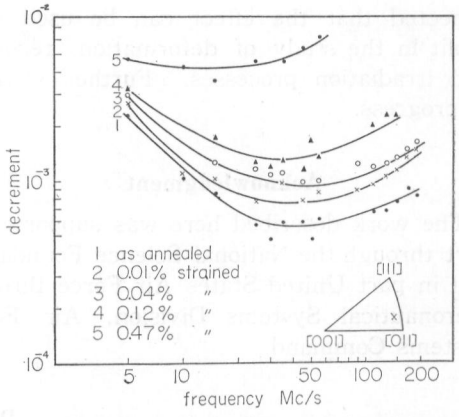

Fig. 1. Frequency dependence of the decrement of annealed and strained crystals.

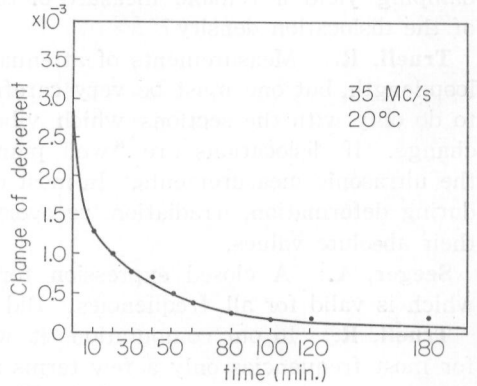

Fig. 2. Recovery of the decrement after cold work (0.63% strained) and its theoretical curve.

* A full manuscript could not be received in time.