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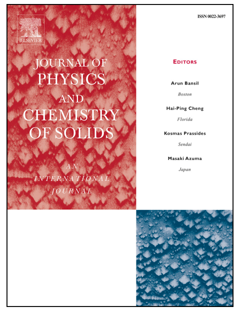

Temperature dependence of magnetoresistance in copper single crystals

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Temperature Dependence of Magnetoresistance in Copper Single Crystals

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Abstract

Transverse magnetoresistance of copper single crystals has been measured in the orientation of open-orbit from 2 K to 20 K for fields up to 9 tesla. The experimental Kohler's plots display deviation between individual curves below 16 K and overlap in the range of 16 K-20 K. The violation of the Kohler's rule below 16 K indicates that the magnetotransport can not be described by the classical theory of electron transport on spherical Fermi surface with a single relaxation time. A theoretical model incorporating two energy bands, spherical and cylindrical, with different relaxation times has been developed to describe the magnetoresistance data. The calculations show that the electron-phonon scattering rates at belly and neck regions of the Fermi surface have different temperature dependencies, and in general, they do not follow T^3 law. The ratio of the relaxation times in belly and neck regions decreases parabolically with temperature as $A - CT^2$, with A and C being constants.

Keywords: Transverse magnetoresistance; magnetotransport; relaxation time; Kohler's rule; Fermi surface; copper single crystals

1. INTRODUCTION

The interaction between conduction electrons and phonons determines many physical properties of metals and alloys, including phenomena such as Peierls distortion [1], Kohn anomaly [2], the temperature dependence of electrical resistivity [3] and superconductivity [4]. A comprehensive review of the early development of theoretical studies on electron-phonon interactions in metals can

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