Size effect and the quadratic temperature dependence of the transverse magnetoresistivity in "size-effect" tungsten single crystals

V.V. Marchenkov[a], **E.P. Platonov**[b], and H.W. Weber[c]

[a]Institute of Metal Physics, 620041, Ekaterinburg, Russia
[b]Ural State University, 620000, Ekaterinburg, Russia
[c]Atominstitut, Vienna University of Technology, 1020, Vienna, Austria

The transverse magnetoresistivity of pure tungsten single crystals with a residual resistivity ratio $\rho_{293K}/\rho_{4.2K}$ of about 75.000 was measured from 2 to 75 K and in magnetic fields of up to 15 T. The size effect, i.e. the linear dependence of the magnetoconductivity on the inverse cross sample dimensions, was studied in detail at high fields. We show that the size effect can be used for the separation of the contributions from the electron-surface and the electron-phonon scattering mechanisms to the full conductivity. We demonstrate that the electron-surface scattering results in a temperature independent term, the electron-phonon scattering leads to the exponential temperature dependence of the conductivity, and the interference between the electron-phonon and the electron-surface processes leads to a new scattering mechanism "electron-phonon-surface" with a quadratic temperature dependence of the magnetoconductivity.

This work was partly supported by the Austrian Academy of Sciences.