Thermodynamical anomalous Hall effect in spin-polarized electron system

E.A. Pamyatnykh,[1] V.I. Okulov,[2] A.T. Lonchakov,[2] and Yu.V. Zabaznov[1]

[1] *Ural Federal University, Ekaterinburg, Russia*

[2] *Institute for Metal Physics, Ekaterinburg, Russia*

Theoretical description of new thermodynamic mechanism of anomalous Hall effect is presented. Consideration is based on separation of magnetization current, resulting from the magnetization M_0 of the system and not contributing to the Hall voltage. The Hall voltage is contributed by the remaining part of locally equilibrium nondissipative current — conduction current j_c, determined by the equality of the force acting in a conductor with current by the magnetic field and the pressure force. As a result, for $\Omega\tau << 1$ (Ω — cyclotron frequency, τ — mean free time of electrons) we obtain the following formula for the Hall resistance: $\rho_H = \rho(\rho\sigma_m + \Omega\tau)$, where ρ — resistivity, $\sigma_m = ec(\partial M_0/\partial\zeta)$ — "conductivity of the magnetization" which does not depend of the magnetic field (ζ — electrochemical potential). This expression contains a linear term on the magnetic field ($\rho\Omega\tau$) and independent of magnetic field anomalous contribution ($\rho^2\sigma_m$). This expression describes experimental dependencies [1].

References:

[1] Lonchakov A.T., Okulov V.I., Govorkova T.E., Andrichuk M.D., Paranchich L.D. — JETP Letters, 96, 444 (2012).