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Anisotropic Magnetoresistance Effects in Fe, Co, Ni, Fe_4N, and Half-Metallic Ferromagnet: A Systematic Analysis SATOSHI KOKADO, Faculty of Engineering, Shizuoka University, Japan, MASAKIYO TSUNODA, Graduate School of Engineering, Tohoku University, Japan, KIKUO HARIGAYA, Nanosystem Research Institute, AIST, Japan, AKIMASA SAKUMA, Graduate School of Engineering, Tohoku University, Japan — We theoretically analyze the anisotropic magnetoresistance (AMR) effects of bcc Fe (+), fcc Co (+), fcc Ni (+), Fe_4N (−), and a half-metallic ferromagnet (−) [1]. The sign in each ( ) represents the sign of the AMR ratio observed experimentally. We here use the two-current model for a system consisting of a spin-polarized conduction state and localized d states with spin–orbit interaction. From the model, we first derive a general expression of the AMR ratio. The expression consists of a resistivity of the conduction state of the σ spin ($\sigma =\uparrow$ or $\downarrow$), $\rho_{s\sigma}$, and resistivities due to s–d scattering processes from the conduction state to the localized d states. On the basis of this expression, we next find a relation between the sign of the AMR ratio and the s–d scattering process. In addition, we obtain expressions of the AMR ratios appropriate to the respective materials. Using the expressions, we evaluate their AMR ratios, where the expressions take into account the theoretical values of $\rho_{s\downarrow}/\rho_{s\uparrow}$ of the respective materials. The evaluated AMR ratios correspond well to the experimental results.

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