External magnetic field influence on exchange coupling in ultrathin Fe/Au/Tb film structures

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In the present work exchange coupling between ultrathin Fe (8 Å) and Tb (12 Å) layers separated by Au spacer of varied thickness (3 - 20 Å) was studied. Film samples were prepared on Si substrates by electron-beam evaporation in an ultrahigh vacuum system having a background pressure of ~ 10^{-8} Torr. Layer thickness during deposition was controlled by a quartz crystal monitor. Evaporation rates were about 0.2 - 0.5 Å/s. Anomalous Hall effect measurements were used to characterize film samples magnetically. Oscillations of the Hall conductivity with the change in sign were observed as a function of Au spacer thickness. But the week damping of these oscillations with increasing spacer thickness did not agree with the character of the dependence obtained from calculations in the framework of RKKY model. The assumption about the influence of external magnetic field on exchange interactions was made. This hypothesis was tested by Hall-like effect based technique which does not require the application of an external magnetic field. The character of observed dependence appeared to be close to the calculated over RKKY model, thus confirming the assumption about the possibility of external magnetic field influence on exchange effects in the investigated film structures. The possible mechanism was considered supposing the change of polarization degree of conduction electrons, involved in exchange interactions, due to the effect of external magnetic field. According to this an attempt was made to take into account the magnetic field influence during the calculation of an appropriate dependence by introducing amendment into the multiplier which characterizes the damping. Calculations via the obtained formula revealed good agreement with experimental data.