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Pd/Co/Pt 積層構造における磁性の電界制御

Electric field control of magnetism in Pd/Co/Pt multilayer

東大物工 [1]，電中研 [2] ○大日方 絢 [1]，早川 大智 [1]，日比野 有岐 [1]，小山 知弘 [1]，三輪 一元 [2]，小野 新平 [2]，千葉 大地 [1]

The Univ. of Tokyo[1], CRIEPI[2], ○Aya Obinata[1], Daichi Hayakawa[1], Yuki Hibino[1], Tomohiro Koyama[1], Kazumoto Miwa[2], Shimpei Ono[2], and Daichi Chiba[1]

E-mail: aobinata@cblb.t.u-tokyo.ac.jp

Recently, control of magnetic properties of ferromagnetic metals by applying gate electric field with a capacitor structure has attracted attention in the research field of spintronics [1,2]. An electric field control of an electron density at the surface of a ferromagnetic metal adjacent to a gate insulator layer plays a main role to cause the change in the magnetic properties of the system. On the other hand, it is known that the magnetic moment is induced in a layer made of Pd, which is normally a non-magnetic element, by contacting it with that of a ferromagnetic transition metal element [3]. Here we report a control of the induced magnetic moment in the Pd layer by applying an electric field.

We deposited MgO/Pd(1.7 nm)/Co(t_{Co})/Pt(4.1)/Ta from the surface side on an intrinsic Si substrate by rf sputtering. To apply large electric field to the Pd layer, we fabricated a capacitor structure with a polymer film containing an ionic liquid[2] to form an electric double layer by applying a gate voltage (V_G). Figure shows the temperature (T) dependence of the perpendicular component of the magnetic moment ($m_\perp$) under the application of V_G of 0 V (black), +2.5 V (red), -2.0 V (blue) for sample with t_{Co}=0.24 nm (positive V_G corresponds to the increase of the electron density in the Pd layer.) When T was sufficiently below the Curie temperature, the V_G-dependent change in $m_\perp$ was observed. This indicates that the induced magnetic moment in the Pd layer could be modulated by V_G, because only the electron density at the surface of the Pd layer is considered to be controlled by V_G. The reproducibility of the result was confirmed in similar samples. The t_{Co} dependence of the electric field effect in this system will be also discussed.

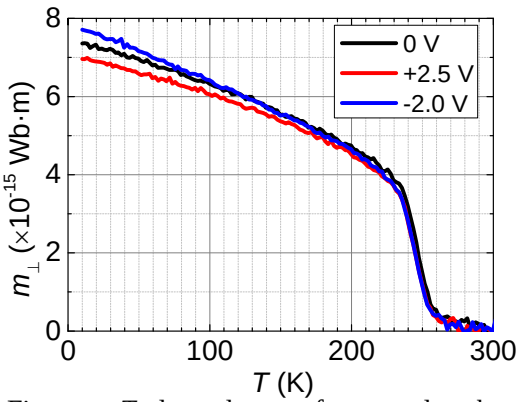

Figure　T dependence of $m_\perp$ under the application of V_G of 0 V, +2.5 V, -2.0 V

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