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

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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(tCo)/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 (VG). Figure shows the temperature (T) dependence of the perpendicular component of the magnetic moment (m⊥) under the application of VG of 0 V (black), +2.5 V (red), -2.0 V (blue) for sample with tCo=0.24 nm (positive VG corresponds to the increase of the electron density in the Pd layer.) When T was sufficiently below the Curie temperature, the VG-dependent change in m⊥ was observed. This indicates that the induced magnetic moment in the Pd layer could be modulated by VG, because only the electron density at the surface of the Pd layer is considered to be controlled by VG. The reproducibility of the result was confirmed in similar samples. The tCo dependence of the electric field effect in this system will be also discussed.

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