Pt/Co 構造における磁気モーメントの電界効果

Electric field effect on magnetic moment in Pt/Co structure

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Electric field control of magnetism in ferromagnetic metals have been intensively studied. Although a modulation of magnetic anisotropy has been mainly focused so far, the electric-field-induced change in Curie temperature T_C and magnetic moment m as well provides an useful information to comprehend the physics behind the effect [1,2]. An application of electric field is expected to cause a shift of Fermi level and a modulation of orbital hybridizations [1]. Thus, a careful tracing of an electric field dependence of m leads to deeper understanding of how the electronic structure is modulated by an electric field application. In this talk, we report the electric field dependence of m in a perpendicularly-magnetized Pt/Co structure using a high-precision magnetization measurement.

Ta (2.5 nm)/Pt (2.4)/Co (0.24)/MgO (2.4) layers were deposited from the bottom side on a Si/SiO_2 substrate using rf sputtering. Subsequently, 50-nm-thick HfO_2 was formed on the sample at 150 ℃ using an atomic layer deposition. Finally, Cr (2)/Au (12) layers were deposited on top as a gate electrode. The perpendicular component of m ($m_\perp$) was measured using SQUID magnetometer under applying gate voltages V_Gs. Fig. 1 shows the change of the areal $m_\perp$ ($\Delta m_\perp/S$) as a function of V_G. To enhance the precision, $m_\perp$ measurement was carried out for 72 times and averaged to plot one data point. The result shows that $m_\perp$ increased (decreased) when the positive (negative) V_G was applied, *i.e.* the electron density at the Co surface increased (decreased). The modulation efficiency of $m_\perp$, which can be determined from the slope of the $\Delta m_\perp/S$ - V_G characteristics, roughly corresponds to 1 μ_B/electron if the Co layer is an fcc structure.

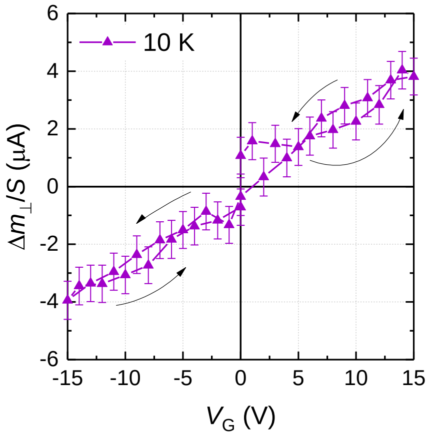

Fig. 1 : The V_G dependence of $\Delta m_\perp/S$ at 10 K. $\Delta m_\perp$ corresponds to $m_\perp(V_G) - m_\perp$(0 V), where $m_\perp$(0 V)/S = 0.37 mA.

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