電気二重層キャパシタンス構造を用いた Co/Pt における磁気モーメントの電界効果

Electric field effect on magnetic moment in Co/Pt using electric double layer capacitor structure

○大日方 絢[1], 早川 大智[1], 三輪 一元[2], 小野 新平[2], 小山 知弘[1], 千葉 大地[1]
(1. 東大物工、2. 電中研)
○Aya Obinata[1], Daichi Hayakawa[1], Kazumoto Miwa[2], Shimpei Ono[2], Tomohiro Koyama[1], and Daichi Chiba[1] (1.The Univ. of Tokyo, 2.CRIEPI)
E-mail: aobinata@cblb.t.u-tokyo.ac.jp

Recently, electric field control of magnetism in metallic structure has been intensively studied[1-4]. Electric double layer (EDL) capacitor is known as one of powerful tools to apply very large electric field to sample. Actually, in a Co/Pt EDL capacitor structure, very large electric field effect on the Curie temperature has been observed[4]. In this work, we directly measured gate voltage dependence of the magnetic moment of Co/Pt structure using the EDL capacitor.

MgO/Co(0.29 nm)/Pt(4.1)/Ta layers from the surface side were deposited on intrinsic Si substrate by rf sputtering. The EDL capacitor structure was formed using a polymer film containing an ionic liquid. We defined that the application of positive gate voltage (V_G) was the direction of an increase in the electron density at the Co surface. Figure (a), (b) and (c) show time (t) charts of the applied V_G, perpendicular component of magnetic moment ($m_\perp$), and the gate current (I_G) at 300 K, respectively. From this figure, one can see that $m_\perp$ increased and decreased reversibly with the application of positive and negative V_G when the magnitude of V_G was smaller than ~3.0 V. When the negative V_G of ~ -3.5 V was applied at t ~ 260 min, $|I_G|$ increased drastically and at the same time $m_\perp$ abruptly became small. After that, $m_\perp$ was constant even when $|V_G|$ > 3.5 V was applied, indicating that the irreversible chemical reaction took place. Electric field effect on $m_\perp$ at low temperature will be also discussed.

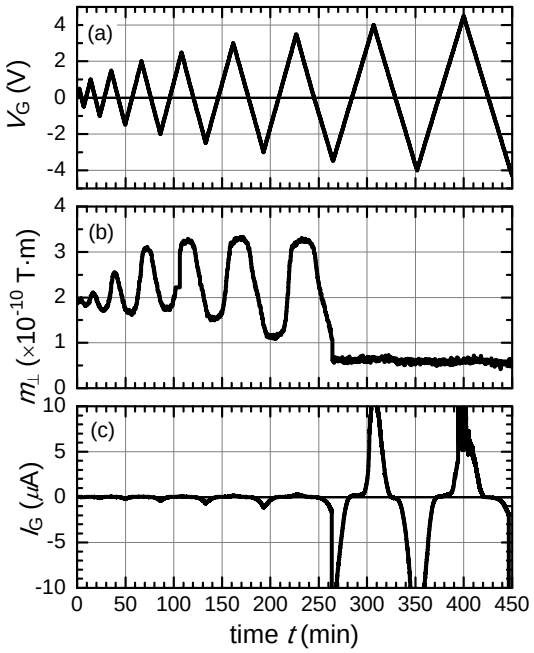

Figure: Time t charts of (a) the applied gate voltage V_G, (b) the gate current I_G, and (c) perpendicular component of magnetic moment $m_\perp$.

This work is partly supposed by Grant-in-Aid for Scientific Research (S) from JSPS.

[1] M. Weisheit *et al.*, *Science* **315**, 349 (2007).
[2] T. Maruyama *et al.*, *Nature Nanotechnol.* **4**, 158 (2009).
[3] D. Chiba *et al.*, *Nature Mater.* **10**, 853 (2011).
[4] K. Shimamura *et al.*, *Appl. Phys. Lett.* **100**, 122402 (2012).