【S-11】 초청강연

Spin-polarized metastable helium atom beam for ultimately surface-sensitive probing

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The performance of solid-state devices is mostly governed by the properties of interfaces contained. In order to obtain information from interfaces, much effort of selecting or examining the right information in the mixture of data is necessary because interfaces are buried in bulk, which dilutes signals from interfaces. Alternatively, some insights on the properties of interfaces can also be attained by investigating solid/vacuum interfaces, i.e., surfaces, on which the effects of adsorbate are probed by surface-sensitive tools. Metastable atoms running at a thermal energy are an ideally surface-sensitive probe because atoms are reflected a couple of angstrom above a surface and interact only with topmost atoms as releasing their internal excitation energy up to20 eV.

Among various properties of interfaces, the electron spin polarization of ferromagnet/barrier interfaces has now attracted substantial attention in conjunction with magnetoresistances in ferromagnet/ insulator/ ferromagnet junctions. It has been also recognized that the electric charge may not be the efficient carrier of information any longer but the freedom of spin should be utilized. Recent progress of organic devices has extended this scope to organic spin devices, in which spin states of interfaces between ferromagnetic and organic materials have to be clarified. We studied surface magnetism, induced spin polarization and the role of spin in desorption and decay phenomena by measuring spin dependences of ejected electrons, desorbed ions and scattered metastable atoms with spin-polarized metastable atom ($He(2^3S)$) beams.

The technological details of our apparatus to produce and to handle spin-polarized $He(2^3S)$ beam, i.e., pulsing of nozzle-skimmer discharge type atom beam source, spin polarization by optical pumping, frequency stabilization of single mode diode lasers and Stern-Gerlach experiment for spin analysis will be presented. After our recent results obtained from

performing spin-polarized metastable deexcitation spectroscopy (SPMDS) [1] measurements for clean and adsorbate (oxygen, alkali [2], organic molecule [3]) -covered iron surfaces are shown, magnetism of ultra thin films [4] and induced spin polarization of surface electrons will be discussed. Spin dependent metastable stimulated desorption [5] and spin dependent metastable atom scattering will also be mentioned.

[1] M.Onellion, et al., PRL 52 (1984) 380.
[2] Y.Yamauchi, et al., J Appl. Phys. 93 (2003) No.10.
[3] T. Susuki, et al., J Phys.Chem. B106 (2002) 7643.
[4] M. Kurahashi, et al., PRB 67 (2003) 024407.
[5] T. Suzuki, et al., PRL 86 (2001) 3654.