Interface structure of Co ultrathin films evaporated on h-BN/Ni(111) studied by LEED Intensity Analysis

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Magnetic tunneling junction (MTJ) structures, where ferromagnetic electrode layers sandwich an insulating barrier layer, show tunnel magnetic resistance (TMR) effect that is widely applied for spintronics devices such as magnetic random access memory. One of important performance factors of TMR element is magnetic resistance (MR) ratio, which is sensitive to not only electronic and magnetic status in the magnetic electrode layers but also the interface structure. Conventional metal oxide layers have been utilized for the barrier layer in the device structures, where improvement of MR ratio is limited because of disorder of the interfacial crystal structures, arises from lattice mismatch, inter-diffusion or defect formation. In recent years, much attention and intensive studies have been devoted to hexagonal boron nitride (h-BN) whose structure is two-dimensional honeycomb formed by stable chemical bonding. Monolayer h-BN is one of good candidates for the ideal burrier layer of TMR devices because the h-BN layer is expected to form an abrupt and pinhole-less interface with magnetic layers. Although a coherent growth of h-BN/Ni(111) is established and the ideal sandwich structure is also expected for Co/h-BN/Ni(111), the growth mode and interface structure for Co overlayer has not been clarified up to now.

In this study, we have investigated growth mode of Co ultrathin films on h-BN/Ni(111) in manner of Auger electron spectroscopy (AES) and intensity analysis of low energy electron diffraction (LEED). The sample of Co/h-BN/Ni(111) was prepared in ultra-high vacuum by means of MBE evaporation of Co on h-BN/Ni(111), where high quality h-BN monolayer was preliminarily prepared on the clean surface of Ni(111) by cracking of borazine ($B_3N_3H_6$) [1]. Thickness dependence of AES intensity ratio of Co (LMM) to Ni (LMM) shows a clear deviation from simple exponential expansion with increasing thickness, meaning a failure of complete layer-by-layer growth. From the LEED I-V curves obtained from the (0,1) diffraction spot of Co/h-BN/Ni(111), peak shifts are found around 80 and 120 eV within the thickness of 1.5~3ML, while no change in the I-V curves is observed above 3ML. According to this result, we can suggest initial island growth followed by two-dimensional epitaxial growth above 3 ML.

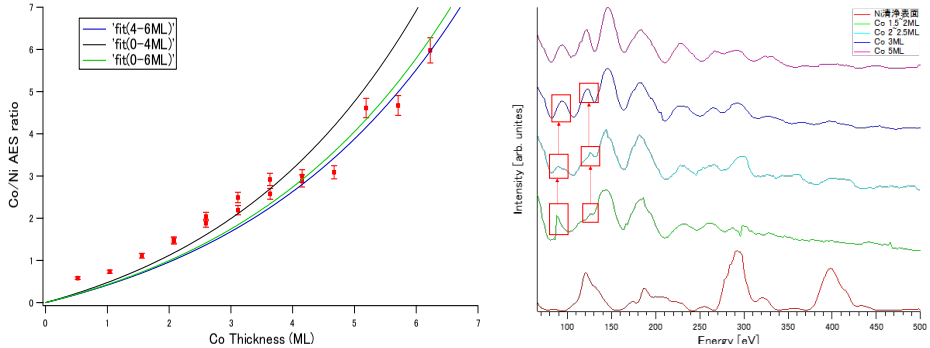

FIGURE. Co thickness dependence of intensity ratio of Auger electron of Co (LMM) to Ni (LMM) obtained from differential Auger electron spectra from Co/h-BN/Ni(111) (left), and LEED I-V curves of the (0,1) diffraction spot (right).

REFERENCES

1. A. Nagashima *et al.*, Phys. Rev. B51, 4606 (1995).