**X-ray absorption and magnetic circular dichroism study of C_{60}-Co hybrid films**

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**Introduction**

In recent years, there has been growing attention to molecular spintronics which aims to realize spin devices utilizing π-conjugated organic molecules (OMs) and nanocarbons (NCs), e.g., graphene, having long spin relaxation times/lengths and tunable electronic properties in the molecular level. Evidence of the large spin-polarization \( P \) at the interfaces between OMs, NCs and ferromagnetic metals, however, has not been successfully reported in the molecular-based spin valves suffering from the problems of identification and control of the transport process around the interface region, despite the importance for realizing highly efficient spin-injection into OMs and NCs.

We have found that a giant tunnel magneto resistance (TMR) effect of \( MR=\Delta R/R_{\text{max}}=80-90\% \) (\( \Delta R/R_{\text{min}}=400-900\% \) in the other definition) occurs in the granular structured hybrid films of C_{60} and Co prepared by the alternate/co-deposition under UHV conditions [1-2]. It was also revealed that the hybrid films are composed of the C_{60}-Co compound matrix (C_{60}Co), which behaves as an insulating region, and Co nanoparticles [3,4]. These preliminary studies predict a possibility of a significant spin-polarization at the C_{60}-Co compound/Co interface. Electronic analysis of the C_{60}-Co compound which would be playing an important role in the spin-dependent electron tunneling process is essential for understanding the nature of the giant TMR effect.

In the present study, the electronic and spin states of the C_{60}-Co compound (C_{60}Co) are investigated using X-ray absorption (XAS) and magnetic circular dichroism (MCD) spectroscopies.

**Experimental results**

Fig. 1(a) shows the typical MCD spectrum of the C_{60}Co film in the Co 2p→3d (L_3,2-edge) region measured under the high magnetic field (\( H=60\)kOe) and low temperature (\( T=6\)K). As shown in the MCD spectra, the peak position (hv=778.0eV) lies at the lower energy side compared to that of the pure Co film (hv=778.2eV). Judging from our previous study [4], the MCD signal is attributed to the spin-polarization of the Co 3d-derived states localized in the C_{60}Co compound. Fig. 1(b) shows the \( H \)-dependences of the spin and orbital magnetic moments (\( M_{\text{spin}} \) and \( M_{\text{orb}} \)) for the C_{60}Co film.

**References**


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