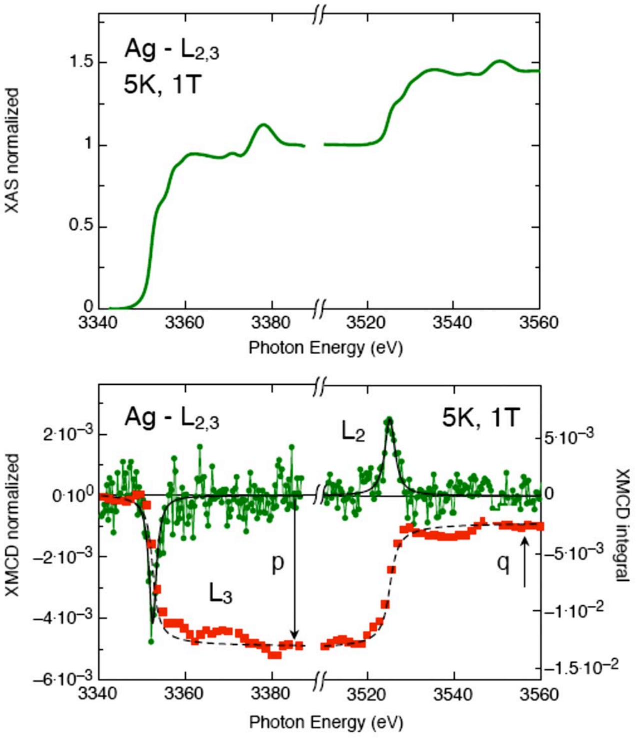

FIG. 8. (Color online) Normalized Ag $L_{2,3}$-edge XAS (top) and XMCD (bottom) spectra of $Si/Al_2O_3/(Co/Ag/Al_2O_3)\times 20/Al_2O_3$. (-) Fit to the Lorentzian function. (■) Area integral; (--) area integral of the Lorentzian. The arrows indicate the higher limit of the *p* and *q* integrals.

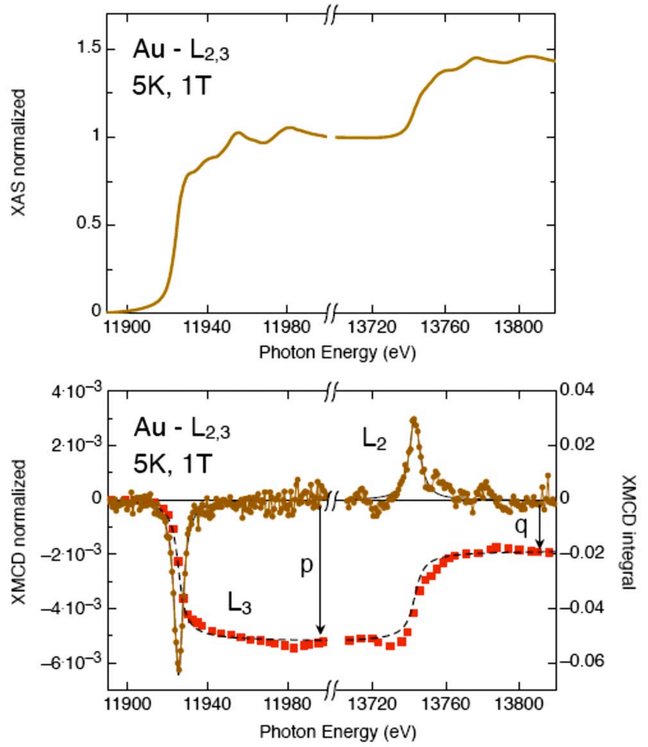

FIG. 9. (Color online) Normalized Au $L_{2,3}$-edge XAS (top) and XMCD (bottom) spectra of $Si/Al_2O_3/(Co/Au/Al_2O_3)\times 25/Al_2O_3$. (-) Fit to Lorentzian function. (■) Area integral; (--) Area integral of the Lorentzian. The arrows indicate the higher limit of the *p* and *q* integrals.

energies at which *p* and *q* have been taken are also shown in AQ: 2 the Figs. 8(b) and 9(b). The error in the integration is considered to be the width of its deviation with respect to the mean guideline and amounts to 15% and 10% in the Ag and Au cases, respectively.

The ratio $m_L^{3d}/m_S^{3d}$ is directly obtained from the sum rules and is independent of any choice in the scaling constant. For Cu, $m_L^{3d}/m_S^{3d}=0.32(3)$, which is larger than the ratio found in other Co granular alloys in the presence of Cu [$m_L^{3d}/m_S^{3d}=0.018$ (Ref. 33)] and in a random $Co_{90}Cu_{10}$ alloy [$m_L^{3d}/m_S^{3d}=0.09$ (Ref. 9)]. However, the factors between $n_h$ and the white-line area, given in Ref. 9, are $C=5.6\mu_B^{-1}$ and $14\mu_B^{-1}$ for the $m_S^{3d}$ and $m_L^{3d}$ sum rules, respectively (normalization of the total $L_2$ and $L_3$ XAS to 1), which yield to $m_S^{3d}=0.010(3)\mu_B$ and $m_L^{3d}=10(3)\times 10^{-4}\mu_B$. If this method is employed, the value for the ratio $m_L^{3d}/m_S^{3d}=0.10(3)$, which is quite low but comparable to other determinations. At any rate, the total moment $m^{3d}=0.011(3)\mu_B$ is deduced, while the orbital moment is very small and practically negligible. It is concluded without ambiguity that the Cu-capping layer is magnetically polarized by the Co particles. It is interesting to note that this value is in the range of the predicted polarization per Cu atom adjacent to a Co nanoparticle.[34]

In the case of the Ag-capped Co particles, a nonzero XMCD at the $L_{2,3}$ edges is observable (Fig. 8), although the signal is very small; the larger $L_3$ peak amounting to just a few per thousand of the XAS signal. Only the high quality of the ID12 beamline at the ESRF has allowed this experiment. The corrected data are shown in Fig. 8. The ratio $m_L^{4d}/m_S^{4d}=0.045(5)$ is extremely small, as compared to Cu (or Au, see later). Therefore, the detected nonzero induced magnetization can essentially be assigned to the spin component. The determination of the constant *C* was derived in Ref. 11 by obtaining the white-line excess area with respect to Ag, $\Delta A_{\mathrm{wl}}$, on one hand, and using the method described for the interpretation of the XAS data[35] to determine the increase in the number of holes in the sample (NiFe/Ag multilayers) $\Delta n_h$, with respect to a pure Ag sample, on the other. Then, finding the quotient $C=\Delta A_{\mathrm{wl}}/\Delta n_h=2.3(2)\mu_B^{-1}$. The value $m_S^{4d}=0.014(3)\mu_B$ is obtained, which is higher than that in Cu. This value can only be compared to $m^{4d}=0.0135\mu_B$ determined for Ag in $Ni_{81}Fe_{19}/Ag$ multilayers.[11] The value of $m_L^{4d}=7\times 10^{-4}\mu_B$ may be considered as negligible.

The XMCD data at the Au $L_{2,3}$ edges performed on the Au-capped Co nanoparticles also indicated that there is a nonzero magnetic moment induced by the hybridization with Co (Fig. 9). The obtained value is $m_L^{5d}/m_S^{5d}=0.10(5)$. This result is in reasonable agreement with the published value of $m_L^{5d}/m_S^{5d}=0.12$,[12] where the value $C=7.8\mu_B^{-1}$ was used to determine $m_L^{5d}$ and $m_S^{5d}$ of Au in a $Co_{12}/Au_4$ multilayer. To derive *C*, the values of $I_{L_2}$ and $I_{L_3}$ were experimentally determined from the white line of a reference $Au_4Mn$ compound (XAS normalization of $L_3$ edge to 1 and of $L_2$ edge to 0.45) with respect to the bulk Au XAS signal and $n_h$ from the difference in the calculated $n_h$ values for $Au_4Mn$ and bulk Au. Using that constant, $m_S^{5d}=0.015(1)\mu_B$ and $m_L^{5d}=1.5(5)$