Using ferromagnetic resonance to measure magnetic moments of ultrathin films (abstract)

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We developed a technique to measure the saturation magnetizatiaon of ultrathin ferromagnetic films using ferromagnetic resonance (FMR). By employing it we determined the ratios of total magnteic moments of ultrathin Fe films located in Ag/Fe/Ag, Au/Fe/Ag, Cu/Fe/Ag, Pd/Fe/Ag, and Ni/Fe/Ag structures relative to that of an Au/5.7 ML Fe/Ag reference film. The ratios obtained using our method have the total measurement error of 1%. All FMR measurements, carried out at 77 K, confirmed theoretical predictions that Fe atoms located at or near interfaces possess enhanced magnetic moments compared with those of Fe atoms in the bulk. In particular, the total magnetic moment ratio for Ag/5.5 ML Fe/Ag and Ag/10.9 ML Fe/Ag (thick Fe) samples was determined to be of 1.06. This compares well to the total magnetic moment ratio of 1.05 calculated for these two films using the results obtained from first principles calculations. The total magnetic moment ratios for Pd/5.6 Fe/Ag, Pd/5.7Fe/Ag, 2(bcc Ni)/5.7 Fe/Ag and 3(bcc Ni)/5.7 Fe/Ag samples using the thick Fe sample were found to be of 1.11, 1.12, 1.15, and 1.24, respectively. The FMR measured magnetic moment ratios were nearly identical with the results obtained from the neutron spin polarized reflection measurements.[1] All measured magnetic moment ratios in Fe films surrounded by the above wide range of interfaces were in excellent agreement with the ratios obtained by using published first principles calculations, and that allows one to determine the enhancement of magnetic moments at the interfaces.
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[1] J. A. C. Bland, D. Daboo, B. Heinrich, Z. Celinski, and R. D. Bateson, Phys. Rev. B **51**, 258 (1995).