SURFACE PLASMON RESONANCE EFFECTS IN THE MAGNETO OPTICAL ACTIVITY OF NOBLE METAL-FERROMAGNET ULTRATHIN FILMS

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We present a combined experimental and theoretical study elucidating the role of surface plasmon resonances in the enhancement of magneto optical activity. Au/Co/Au trilayers were grown on glass substrates by ultra-high-vacuum deposition and the thickness of the ferromagnetic layer was systematically varied between 0.3 and 10 nm. A comprehensive structural, magnetic and magneto-optical characterization of the different layers is provided. Simulations of both Kerr spectra and reflectivity were carried out using a transfer matrix algorithm applied to the multilayers. [1]

For specific Co and Au layer thicknesses, the excitation of surface plasmon resonance at the Au/air interface in the Kreschmann configuration leads to an enhanced transverse Kerr effect. This is due to the optimized coupling of the incident light with the excited plasmon resonance and the subsequent enhancement of the electromagnetic field at the magneto-optically active layer. Theoretical calculations permit the separation of the individual contributions to the transverse Kerr signal (ΔR/R) from the purely magnetic (ΔR) and optical (R) parts. It is found that the enhancement in ΔR/R is not only due to a reduction in R [2] but also due to an enhancement in ΔR for specific layer thickness and incidence angles, correlated with the specific absorption coefficients of Co. This finding provides new insights in the understanding and interpretation of magneto-plasmonic phenomena.

References:

[1] J.B. González-Díaz, submitted to Phys. Rev. Lett., (2007).
[2] V.I.Safarov et al., Phys. Rev. Lett. **73** (1994) 3584; N. Richard et al., Phys. Rev. B **59**, 5936 (1999); C. Herman et al., Phys. Rev. B **64**, 235422 (2001).

Figures:

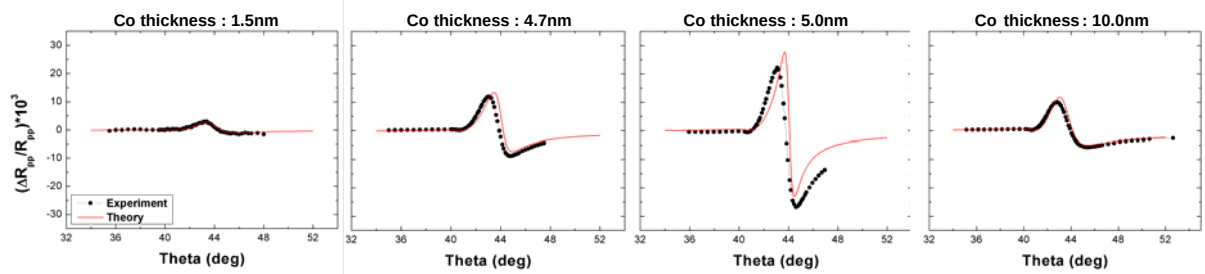

Figure: ΔR/R vs incidence angle for different Co thickness (6nm Au/Co/16nm Au/glass). ΔR/R does not continuously increase with Co thickness, but reaches a maximum value for 5 nm Co.