Abstract Title

Magneto-optical and plasmonic properties in composite Au-Co active surfaces

Symposium Track

Fabrication at the nanoscale

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Abstract body

Magnetic nanoparticles embedded in a suitable matrix are able to form an active surface that can be further developed into a biological sensor based on surface plasmon resonance (SPR) enhancement of the optical activity. Most current sensing schemes involving SPR are "passive", i.e. they are simply based on changes in optical properties of a noble metal (e.g. gold) surface. It is highly desirable to have "active" surfaces where some optical property can be varied for example under application of an external field. This design would allow exploration of more sensitive modulated detection schemes. A magnetic nanoparticle is an "active" structure because the magnetization state can be changed by an external magnetic field. For example it has been observed that multilayer films of Co and Au [1, 2] exhibit optical phenomena related to surface plasmons that can be controlled by an externally applied magnetic field. It has also been observed that particulate recording media re-emit optical radiation in a narrow beam at high non-specular angles consistent with radiative decay, [3] due to localized surface plasmons (LSP) i.e. charge density oscillations confined to metallic nanoparticles. [4] A nanoscale based sensor operates in a manner analogous to SPR sensors by transducing small changes in refractive index near the noble metal surface to a measurable optical response. Important to the development of this active surface is the choice of fabrication methods for the self-assembly of magnetic nanoparticles on or embedded in a surface. In addition to the appropriate choice of materials, the particle size and separation will strongly determine the magnetic and magneto-optic behavior of embedded arrays of magnetic nanoparticles [5]. Also, the environment surrounding the nanoparticles plays a crucial role because even if it is non-magnetic, it may be polarized thus affecting the global behavior of the system. [6] We have been able to demonstrate that Fe ions implanted on epitaxial Pt films form shallow nanoclusters that after annealing self-assemble into a highly ordered phase ($L1_o$) with enhanced magnetic anisotropy as well as magneto-optical properties. Figure 1 below shows a magnetic force microscopy (MFM) image of such surface where nano-regions of high magnetic contrast are observed due to perpendicular anisotropy. In the same figure we show the energy-dependence of the Kerr activity in such sample, where again it is clearly noted that there is an enhancement of the Kerr angle and ellipticity after formation of ordered and highly anisotropic magnetic nanoclusters.

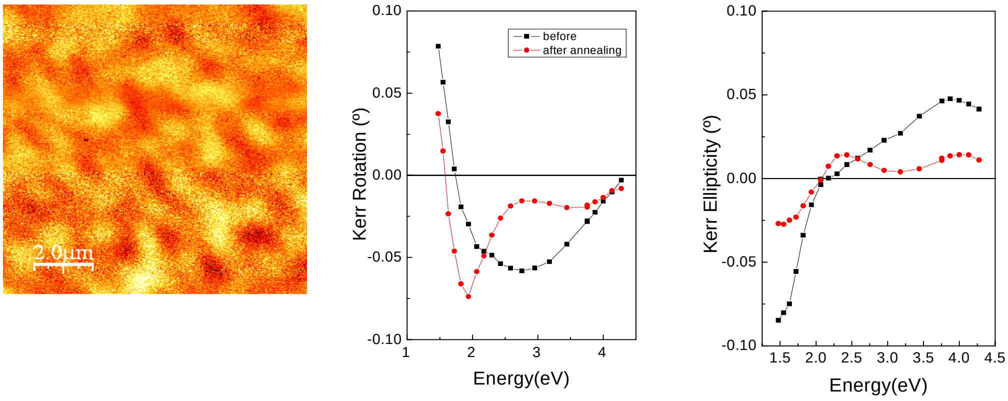

Figure 1. (a) MFM image of Fe implanted Pt film after annealing at 400°C for 30 minutes. **(b)** Kerr angle and **(c)** Kerr ellipticity as function of incident photon energy (black: before; red: after annealing).

We will present our latest results on the Au/Co system. The Au films have been grown over glass substrates, and the ferromagnetic material has been implanted with varied implantation conditions so that the optical and magneto-optical response can be tailored. Complete structural, magnetic and magneto-optical characterization of the structures will be provided.

Keywords

Magneto-optics, plasmonic, nanostructures

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