HYBRID PLASMONIC LATTICES WITH TUNABLE MAGNETO-OPTICAL ACTIVITY

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Here, we present a new versatile method of integrating ferromagnetic and noble metal plasmonic nanostructures leading to strong magneto-optical responses in conjuncture with drastically enhanced optical reflectivity. The structures under study consist of Ni and Au nanoparticles that are ordered into periodic checkerboard arrays. The Au constituent of these hybrid arrays guarantees intense optical reflectivity. Yet, compared to pure nickel arrays [1], the magneto-optical signal is practically retained.

While the optical response of individual ferromagnetic nanoparticles is limited by ohmic losses, checkerboard arrays of Ni and Au nanoparticles combine intense optical resonances with strong magneto-optical activity (Fig. 1). The effects are caused by diffractive far-field coupling between the magnetic and noble metal components of the hybrid arrays, as confirmed by DDA model calculations and FDTD simulations. Since the underlying interaction mechanisms are generally applicable, we anticipate that our results will stimulate work on other mixed particle configurations such as rectangular and hexagonal lattices.

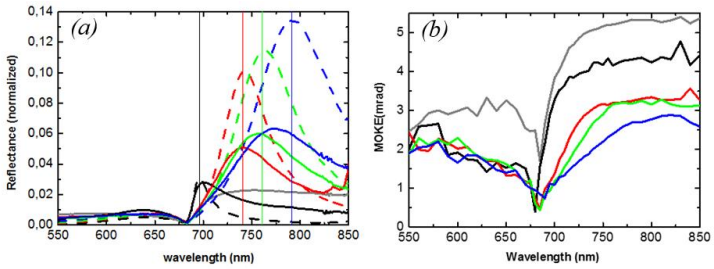

Figure 1 (a) Optical reflectivity of Ni, Au, and Ni-Au nanoparticle arrays with a periodicity of 450 nm. Solid gray line: Ni (dNi = 120 nm). Dashed lines: Au (dAu = 80, 100, 110, 120 nm). Other solid lines: Ni and Au nanoparticles in a checkerboard pattern (d_{Au} = 80, 100, 110, 120 nm, d_{Ni} = 120 nm). (b) Magneto-optical Kerr effect of Ni and Ni-Au nanoparticle arrays (same labelling as in (a)).

[1] M. Kataja, T. K. Hakala, A. Julku, M. J. Huttunen, S. van Dijken, P. Törmä, "Surface lattice resonances and magneto-optical response in magnetic nanoparticle arrays," Nat. Commun. **6**, 7072 (2015).