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Near-field optical microscopy of plasmonic metamaterials JI-YOUNG KIM, VLADIMIR DRACHEV, HSIAO-KUAN YUAN, XIANFAN XU, Purdue University, VLADIMIR SHALAEV, Purdue Univeristy — We have studied the effect of aperture-sample interactions on the near-field optical imaging and its application for plasmonic metamaterials. Specifically, periodic arrays of paired and single gold nanorods were studied at the near-field using reflection and transmission modes of a near-field scanning optical microscope (NSOM) at various wavelengths and polarizations of light in the visible range. The paired nanorods act like nanoantennae in resonant coupling. In non-resonant coupling, enhanced reverse contrast in reflection is observed with strong polarization dependence and the average near-field transmission exhibits an opposite sign of anisotropy relative to the far-field case. The results demonstrate that the broad angular spectra of small-aperture sources play a crucial role and also show that angular redistributions of these spectra after transmission or reflection from the nanorod array are likely due to excitation of localized and propagating plasmons. We quantify this probe-nanorods system using Finite Difference Time Domain (FDTD) simulations. By varying the NSOM tip geometry and the wavelength we determine and tune the resonance wavelengths of the probe-sample system where the near-field interaction is enhanced. The near-field maps of the electric and magnetic fields in the metamaterial structure are also obtained.

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