NANO HIGHLIGHT
Nanofabricated All-Optical Computing, Switching, and Signal Processing Devices Based on Single Photon Tunneling

NSF NIRT Grant 0304046

PIs: **C.C. Davis[a], I.I. Smolyaninov[a], J. Melngailis[a], A. Stanishevsky[b], and A. Maradudin[c]**
[a]University of Maryland, [b]University of Alabama at Birmingham, and [c]University of California at Irvine

Optical properties of nanohole arrays in metal films are the topic of considerable current interest, due to the strong drive towards development of a new generation of nano-photonic devices for nanotechnology, communications and computing. Transmission of light through nanoholes may only happen via classically forbidden quantum tunneling, since the size of these structures is much smaller then the wavelength of light. If researchers can master the unusual optics of nanostructures, extremely compact computing and communication devices will become the reality of the next decades. The goal of the NSF-supported team of researchers from the University of Maryland, College Park, University of Alabama at Birmingham, and University of California at Irvine is to study potential applications of nonlinear optics of nanohole arrays in image and signal processing. After studying the optics of extremely small natural pinholes in metal films, which showed first indications of nonlinear behavior, the team succeeded in demonstrating nonlinear interaction of light in artificial pinhole arrays with features as small as 20 nm. Nonlinear nanoholes and nanohole arrays may become very promising single photon sources for quantum communication and cryptography applications. Our most recent results indicate that the properties of such sources may be controlled by modest external magnetic field, which would be very attractive in device applications. It also appears that arrays of such nanoholes may exhibit rather prominent magnetic properties in the frequency range of cylindrical surface plasmon excitation. Thus, nonlinear optical interactions of light inside the nanoholes may be described as an effective magnetic interaction, and a novel class of "magnetic light" metamaterials may be designed and created.

Quantum light sources controlled by external magnetic field?

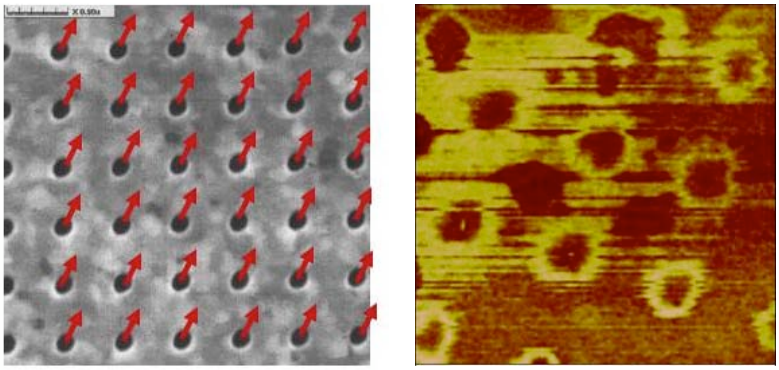

Fig.1 (a) Cylindrical plasmons in nanoholes posses magnetic moments, as indicated by the arrows. (b) Magnetic force imaging of a nanohole array illuminated with circular polarized light.

References

[1] For further information about this project email to **smoly@eng.umd.edu**