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Magnetic Dot and Anti-Dot Array Fabrication Via Nanosphere Physical Masks

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Poster Presentation 1

MAGNETIC DOT AND ANTI-DOT ARRAY FABRICATION VIA NANOSPHERE PHYSICAL MASKS

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We discuss non-lithographic means of controlling the assembly of nanoparticles onto a substrate. Once assembled, the collection of particles serves as a physical mask, selectively protecting areas of the underlying substrate from a reactive plasma or from physical vapor deposition. Because the clear, line-of-sight channels between the masking particles are much smaller than the particles themselves, extremely fine features can be transferred to the substrate. This novel technique for nanopatterning is inexpensive, can work on curved surfaces, and over extremely large areas.

We also discuss the use of our method to produce arrays of magnetic dots on, or arrays of holes in, a superconducting thin film; here, these arrays serve to 'pin' otherwise mobile quantum vortices. Significantly, these 'pinscapes' can be large enough to be in the thermodynamic limit. Moreover, we can tune the degree of disorder in the array of pinning sites, as well as the strength, size, and lattice constant of the pinning centers.

We aim to investigate the collective behaviors that result from the competition between vortex-pinscape interactions and vortex-vortex interactions. Such tailored samples should allow us to explore a variety of phases of vortex matter, as well as the transitions between these phases.