concepts in designing nanoscale electronic and photonic devices. The Symposium offered sessions on quantum dots, nanoparticles, nanowires, self-assembly, photonic crystals, and molecular electronics and photonics. This topic stimulated interactions between researchers from a broad range of areas as a joint session was held with Symposia J and P on self-assembly.

L. Brus (Columbia) described some recent studies related to the electronic structures of 1–2 nm silicon nanocrystals whose surfaces are passivated with oxide shells and hydrogen atoms. M. Sailor (UCSD) discussed how nanoparticles made of porous silicon (called "smart dust") could be encoded with photonic features and then used to detect toxic chemicals and biological species. D. Norris (Univ. Minnesota) described a simple and convenient method for derivatizing quantum dots with hydrophilic lipids, as well as their use as fluorescent labels in biological systems. X. Peng (Univ. Arkansas) explicitly discussed the rational synthesis of semiconductor nanocrystals with controllable sizes and aspect-ratios. C. Murray (IBM) presented a solution-phase method for the synthesis of PbSe nanocrystals and nanowires. R. Vaia discussed a range of research activities at the AFRL related to the fabrication of organic–inorganic hybrid photonic systems. V. Colvin (Rice Univ., California) illustrated how biological nanostructures such as viruses could be used as templates to generate 3D metal nanostructures.

In the joint session, G. Stucky (UCSB) demonstrated how self-assembly on different scales could be exploited to create nanostructures for various applications. P. Wiltzius (Univ. Illinois) discussed the use of self-assembly (with spherical colloids as the building blocks) and two-photon optical lithography in generating photonic crystals.

C. Murphy (Univ. South Carolina) discussed a seed-mediated method for the synthesis of gold and silver nanorods with controllable aspect ratios. W. Buhro (Washington Univ., Missouri) presented recent studies on the synthesis and optical characterization of quantum wires made of III–V and II–VI semiconductors. N. Abbott (Univ. Wisconsin—Madison) discussed how liquid crystals could be used as an amplifying system for detecting biological species. S.A. Jenekhe (Univ. Washington, Washington) described the rational design and self-assembly of conjugated polymers into uniform nanowires. J. Rogers (Bell Laboratories/Lucent Technologies, New Jersey) discussed a number of methods for fabricating electronic devices from soft organic

Nanomagnetism Pushes the Limits of Site and Characterization Scales

Symposium R focused on "pushing the limits" in the field of nanomagnetism, making structures smaller (nanoscale) and characterizing them with increased accuracy and decreased measurement time scales (femtosecond range).

Nanostructured magnets with controlled sizes have been prepared using electron beams, porous alumina (K. Nielsch, MIT and I. Roshchin, UCSD), block copolymers (M. Tuominen, Univ. Massachusetts and C.A. Ross, MIT), scanning probe lithography (C. Van Haesendonck, Katholieke Univ. Leuven, Belgium), and laser interferometry (Ross). This makes artificially prepared nanomagnets extremely useful for studies of magnetism in confined geometries and hold promise in a variety of applications in the storage and sensing technologies (J. De Boeck, IMEC, Belgium). Examples of some of the most representative techniques for the preparation of nanomagnets are shown in the figure.

Characterization of nanostructured materials is a challenging endeavor. E.D. Dahlberg (Univ. Minnesota) described difficulties that occur using MFM and argued that these techniques must be combined with quantitative micromagnetic calculations. TEM can determine detailed magnetic structures at the nanoscale level (J. Chapman, Univ. Glasgow). The use of reciprocal space techniques such as neutron scattering and synchrotron radiation are at a stage where quantitative measurements can be obtained from small quantities of material (S. Sinha, UCSD and B.M. Barnes, Univ. Wisconsin—Madison). Several novel synchrotron-based techniques have been developed which allow element-specific characterization (J. Stöhr, Stanford and J.-P. Locquet, IBM-Switzerland). A novel first-order-reversal-curve method (K. Liu from UC—Davis) gives extremely detailed information on the reversal process of nanomagnets.

Nanostructured magnets exhibit physical phenomena that were unexpected by simple models or micromagnetic calculations. These include the development of vortex states due to the interplay between spatial confinement and magnetic energetics, modification of reversal processes in exchange-biased nanomagnets (I.V. Roshchin, UCSD), and unusual magnetic states in square (M. Grimsditch, Argonne) and interacting rings (V. Metlushko, Univ. Illinois—Chicago). The search for enhanced ballistic magnetoresistance has given negative results in lithographed Ni (A. Lukaszew, Univ. Toledo) and Co (M.I. Montero, UCSD) nanobridges. Nanostructured magnetic tunnel junctions show interesting magnetic imprinting effects (J.L. Costa-Krämer, CNM-CSIC, Spain). New magnetic materials have been discovered using fullerenes as the basic building blocks (K.V. Rao, Royal Inst. of Technology, Sweden).

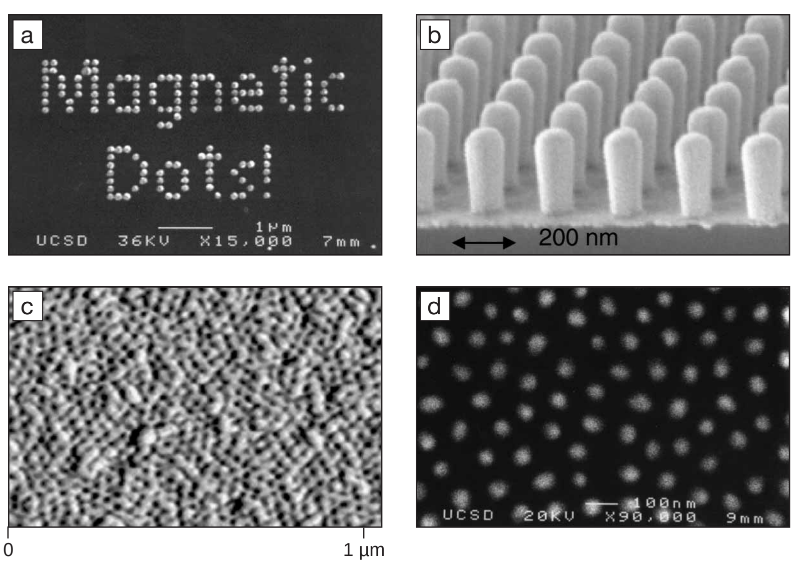

Figure. Nanolithography methods: (a) electron beam; (b) laser interference; (c) diblock copolymer; and (d) alumina nanopores. Prepared by I.V. Roshchin. Images provided by A. Hoffmann, C. Ross, K. Liu, C.P. Li, and I.V. Roshchin.