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Preface: Nanowires

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Inorganic chemistry and nanoscience are coupled by the intellectual and practical need to relate structure to physical properties and the chemist's talents to make and discover new solid-state materials and to prepare them in new, often unusual, shapes and sizes. The past several decades have seen a significant effort worldwide in nanoscience, especially in the preparative chemistry of nanostructures with a desired size, shape, and/or composition. This is the foundation on which nanoscience is built, and it is where inorganic chemists have played, and will continue to play, a pivotal role.

A rich variety of methodologies have already been developed for synthesizing colloidal nanoparticles with well-controlled dimensions from a broad range of materials. When exhibiting quantum size effects, these colloidal nanocrystals are often referred to as "quantum dots" in the literature. A wealth of interesting chemistry and physics has been discovered for these systems and the evolution of their fundamental properties with size. Significant research advances in the area of carbon nanotubes, with their unique one-dimensional nanostructures, have excited researchers worldwide around the question of how anisotropy on the atomic and nanoscopic level can modify and enhance chemical and physical properties. With nanostructures as functional components, a variety of nanoscale devices have been fabricated as prototypes by many research groups around the world, with notable examples including quantum dot lasers, single-electron transistors, logic and memory units, as well as light-emitting diodes.

The theme of the *Inorganic Chemistry* Forum in this issue is Nanowires, a class of nanomaterials that is enjoying enormous current research interest, with about 3000 papers published on this topic in 2005 alone. Some of the early papers on nanowires are already collecting more than 1000 citations. Nanowires, by definition, are anisotropic nanocrystals with large aspect ratios (length/diameter). Generally, they would have diameters of 1−200 nm and lengths up to several tens of micrometers. Because of their potential applications in technology, as well as the fundamental interest in how they form, nanowires have stimulated widespread interest and research activity in both academia and industry. Nanowires are now considered to be ideal systems for investigating the dependence of optical, electrical, magnetic, and mechanical properties on size and dimensionality. They are expected to play important roles as both interconnects and functional components in the fabrication of nanoscale electronic and optoelectronic devices. Indeed, within the past decade, many unique and fascinating properties/applications have been demonstrated or proposed, such as nanoscale lasers, nanowire transistors, photodetectors, and chemical/biological sensors, as well as energy conversion devices for photovoltaics and thermoelectrics.

The fast-paced success of nanowire research is largely built on the synthetic capabilities chemists have achieved for this class of nanostructures. Nanowires, with their tightly controlled dimensions, orientations, and compositions, can now be synthesized readily using various solution and gas-phase synthetic methodologies. The Forum on Nanowires intends to highlight some of the most recent and exciting progress in metal and semiconductor nanowires, as well as delineate some of the challenges facing chemists working on such systems. To start, Buhro et al. present a historical overview of the solution−liquid−solid nanowire growth mechanism and give a direct comparison with the more traditional vapor−liquid−solid nanowire growth processes. The Forum contribution by Li describes a general understanding of the correlation between the crystal structure and growth behavior of materials under solution-based conditions, while indicating how to choose appropriate conditions for the growth of one-dimensional nanostructures. In the Article by Yang et al., strategies for growing ZnO nanowires from zinc salts in aqueous and organic solvents are recounted and the use of

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these solution-grown nanowire arrays in dye-sensitized solar cells is described. The Forum contribution by Murphy et al. focuses on the solution synthesis of single-crystalline silver and gold nanorods, while that by Mallouk et al. reviews the growth of metal nanowires employing membranes as hard templates and highlights recent applications in superconductivity, optical spectroscopy and sensing, and the conversion of chemical to mechanical energy.

The Forum Articles in this issue represent a snapshot of a very active research area. Nanowire research possesses a bright and stimulating future as the fundamental understanding of precise structural control combines with key challenges in the applications of nanowires and their syntheses to offer all scientists a most fertile field in which to work.

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