The Next Decade of Nanoscience and Nanotechnology

The rapid rise in visibility and impact of *ACS Nano* is incredibly satisfying to all of us who work with the journal and is, of course, a tribute to the authors, as it is a consequence of the exciting advances reported here. In addition, it is a testament to the vitality of the field of nanoscale science and nanotechnology, which continues to be fertile ground for discoveries that have impacts for both fundamental understanding and technological applications.

The timing of the origin of nanotechnology can be debated and depends somewhat on the definition being employed, which in turn depends on the context of the conversation. However, the start of the National Nanotechnology Initiative in the U.S. is well-defined: 2001, with the Congressional budget approval establishing nanoscale science and technology as a federal initiative. At nearly the same time, similar initiatives were launched in other countries, including Japan, Korea, China, Germany, Switzerland, the European Union, and elsewhere.

The past decade has indeed seen transformative changes in the scientific landscape due to nanoscience and nanotechnology advances.

It is interesting after nearly a decade to reflect on the impact of those investments and ask ourselves what should be the focus of the next decade. To this end, several reports were commissioned in the U.S. this year. The most recent is an assessment of the global impact of the past decade of nanotechnology led by Dr. Mike Roco, Senior Advisor for Nanotechnology at the National Science Foundation.[1] A committee of U.S. scientists[2] from across the nanotech multidisciplinary spectrum visited colleagues in the U.S. and from 20 countries in Europe and Asia, as well as Australia, to develop an informed perspective of the advances of the decade.

This review reveals that the past decade has indeed seen transformative changes in the scientific landscape due to nanoscience and nanotechnology advances. A reminder of the changes would include the following:

- Although plasmons have been around for decades, the ability to exploit them in nanostructures led to the burgeoning new field of plasmonics, which did not exist 10 years ago and is producing new technologies.
- After many years of new physics and innovative device configurations arising from the study of fullerenes and nanotubes, graphene exploded onto the scene and may enable the realization of the carbon-based systems. That the Nobel Prize in Physics recognized this new field this year is an indication of the significance of these advances (see the Nano Focus in this issue by Dresselhaus and Araújo[3]).
- Combinations of near-field optical physics and biochemistry are producing gene sequencing solutions that may soon meet the $1000/genome challenge and are enabling single-molecule tracking in dynamic systems such as motor proteins.
- New families of hybrid materials/structures are being discovered that exhibit multifunctional behavior, such as multiferroics, spin torque systems, plasma-induced electronics, and bio-optoelectronics.[4]

Published online November 23, 2010.
10.1021/nn102952y

IMAGE COURTESY OF SAM LEVITAN

Prof. Mark Hersam of Northwestern University joined *ACS Nano* as an Associate Editor this month.

- Though local probes of atomic- and molecular-scale structure have been around for more than a decade, the last 10 years have seen dramatic extensions to imaging complexity and function at atomic levels. Advances such as nano nuclear magnetic resonance, spin excitation, and dielectric function portend a generational leap in our ability to understand nanoscale phenomena. Note that the 2010 Kavli Prize in Nanoscience acknowledged this.
- The new field of nanotoxicology and environmental health and safety is developing the scientific underpinning and social framework for responsible nanotechnology development (see *ACS Nano*'s Virtual Issue on nanotoxicology[5]).

This list is in no way comprehensive but is an attempt to illustrate how dramatic the changes of the past decade have been. (Apologies if I have omitted your favorite topic.) With these advances, the global scientific community is poised as never before to make substantive impact on the grand challenges we face in medicine, energy, information technology, and environmental stewardship.

Unsurprisingly, these are topics at the core of *ACS Nano*, as a quick survey of any of the last few issues will show. It is, I think, the same enthusiasm evident from this "decade review" that drives the research that finds its way to our pages. We look forward to your future contributions as you help define the next decade of nanoscale science and technology.

This month we are happy to welcome Prof. Mark Hersam as our newest Associate Editor. Mark is a Professor of Materials Science and Engineering and Professor of Chemistry at Northwestern University. He brings experience in developing new materials, novel lithography, and local probes.[6−11]

Dawn Bonnell
Associate Editor

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