

New Tools Lead to New Science

The worldwide revolution that we have seen in biotechnology has been enabled by the development of new tools.^{1,2} These tools targeted key bottlenecks that previously prevented us from sequencing genomes and synthesizing DNA and proteins. Once available, new scientific frontiers opened as new questions could be asked and addressed. While the human genome project may not yet have had the impact in medicine that was predicted at the outset, both the *scientific* advances and the generation of new *questions* have been extraordinary. One of the principles on which we founded *ACS Nano* was that we would identify and address the challenges of nanoscience and nanotechnology.³ Here, I ask you to consider and to help identify the equivalent bottlenecks and solutions in our fields.

We have published several discussions along these lines, starting with our very first issue.^{3–6} In our Conversation, Chad Mirkin pointed out that while some of what we want to be able to do is nearly accessible and we can glimpse where we want to be, we often need to improve our capabilities substantially in order to proceed.⁶ Again, the analogy to biotechnology is striking in the way that automated and high-throughput tools have led to the dramatic advances in biology that we are now seeing. What are the equivalent advances to come in nanoscience?

I think that we can all agree that better synthesis and measurement tools are critical. New levels of understanding have already come from precise syntheses of nanoparticles,^{7,8} well beyond our understanding of the structures and properties of the nanoparticles themselves. New applications in electronics and sensing have come from our ability to create and to manipulate graphene and other materials with extraordinary properties.^{9–11} New understanding has come from a complement of tools that have been developed over the last 30 years, since the invention of the scanning tunneling microscope and its progeny.^{4,12–16} Likewise, theory, simulation, and computational efforts and capabilities have advanced but still have a long way to go to explain and to predict materials and their properties.¹⁷

In order to advance our understanding and capabilities significantly further, we have to ask what is special about nanomaterials? One answer is our growing ability to form them into hierarchical and precise assemblies with increasing complexity.^{18–20} The more precisely we can control these assemblies, the more that we can gain new control of properties and function. In some cases, these efforts aim to explore new forms of matter; in others, the aim is to address some of the world's most important problems, such as energy capture and storage, or targeted therapeutics and diagnostics. An example of the latter is featured on the cover of this issue, from Drs. Carlee Ashley, Jeff Brinker, and their groups.²¹

The flip side of this story is that many nanomaterials are not yet well-defined. In these cases, we need new high-throughput methods to sort properties such as biological interactions.²² Trying to use conventional means to sort through hundreds of thousands of new materials simply is not feasible. Thus, both the methods development and the associated informatics issues remain significant challenges, requiring concerted efforts in our communities.

On all these topics, we hope that having *ACS Nano* to share both challenges and successes across communities will help accelerate advances by cross-fertilizing efforts and by inspiring scientists and engineers around the world.

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Published online March 27, 2012
10.1021/nn301088h

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Professor Andre Nel of UCLA joins *ACS Nano* as an associate editor.

In April, we welcome Prof. Andre Nel of UCLA as our newest associate editor. Prof. Nel is a dominant figure in the areas of nanomedicine and nanoenvironmental health and safety.^{22,23} He runs the largest center in the world focused on the latter topic, in which *ACS Nano* has become the premier venue. He is a frequent contributor and our most-cited author. In addition, he is a leading clinical immunologist and has been included for more than a decade as one of the peer-selected Best Doctors of America. Please join me in welcoming him.

Paul S. Weiss
Editor-in-Chief

Acknowledgment. P.S.W. would like to thank Drs. Anastassia Alexandrova, Anne Andrews, Robert Damoiseaux, Sharon Glotzer, and Lee Hood for helpful suggestions and discussions.

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