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Nanoscience and Nanotechnology Impacting Diverse Fields of Science, Engineering, and Medicine.

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EDITORIAL

Nanoscience and Nanotechnology Impacting Diverse Fields of Science, Engineering, and Medicine

As 2016 comes to a close, we find that that the importance and impact of nanoscience and nanotechnology continue to rise and to expand. This year, on the first Nano Day (October 9), we celebrated the National Nanotechnology Initiative in the United States and related efforts around the world.[1]

Figure 1. The National Microbiome Initiative is one of several where nanoscience and nanotechnology are playing key roles both in science and technology and in leading the communication across traditional disciplinary boundaries.[5] Artwork credit: Ms. Andrea Selby, used with permission.

As we have noted repeatedly in *ACS Nano*, a critical advantage for nanoscience, nanotechnology, and those in these fields is that we have learned to communicate across disciplinary boundaries and to appreciate and to try to address each other's problems and opportunities.[2] As a result, the nanoscience and nanotechnology communities are playing key and leading roles in diverse scientific initiatives,[3] ranging from the BRAIN Initiative,[4] to microbiome[5] and precision medicine initiatives, to brain-inspired computation,[6] novel materials,[7] and more. We are honored that *ACS Nano* also plays an important role in proposing and elaborating what it would take to tackle these efforts and to make them successful as well as what the important consequences would likely be. We see part of our role as ensuring that other scientific communities are engaged, contributing, and supported. In important areas where no major initiatives have been announced, such as energy harvesting and storage, we bring together key perspectives and ideas to accelerate advances and to identify challenges to tackle and opportunities to address. Starting in the coming year, we will look at how technologies can cross boundaries and address these and other grand challenges (stay tuned). We also look for opportunities to bring together diverse groups around the world; the scientific community has been and must continue to be a global connector. We frequently hear back from you on the impact of these scientific and other efforts, and we thank you for this terrific feedback.

> A critical advantage for nanoscience, nanotechnology, and those in these fields is that we have learned to communicate across disciplinary boundaries.

We have seen time and again that such national, international, and also local investments in science and technology development pay off many times over, both scientifically and economically[8] By addressing important issues in science, engineering, and medicine, there are even greater returns in opening up new areas of investigation and opening up new industries, treatments, and more.[9−11] For example, we can contribute to solving the most important problems that the world faces by targeting the water, energy, and food security nexus—these areas are linked, and nanomaterials play major roles in both the delivery of resources (*e.g.*, generation of energy and drinking water) and safety (from energy storage to sensors for water and food).

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While the initial objective of the human genome project stemmed from the idea that by reading our DNA, we would solve many problems in human medicine, our 3 billion base pair genomes turned out to have surprisingly few genes (~21,000), which, through mixing and matching as well as about 100 different post-translational modifications, produces an estimated *ca.* 1 million different proteins. Likewise, the direct linkages between genes and specific diseases turned out to be much more complex than originally thought. The greatest impact of the effort came more in the technology developed late in the project for efficient, fast, and economical sequencing, rather than from earlier brute force approaches simply to read human DNA. The tools developed enabled us to ask previously unthinkable questions by sequencing and comparing the genomes of hundreds or thousands of organisms. Such enabling questions and studies have led to new fields and have in turn catalyzed extraordinary and important advances.

We also try to identify aspects of science, engineering, and medicine that through neglect and/or lack of support could hinder further progress. One such area is fundamental electrochemistry.[12] In many institutions, it went out of fashion, and there has been a contraction of both the field and

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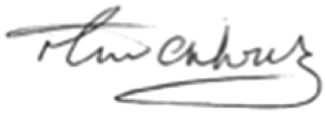
instruction in it, yet electrochemistry is critical to energy harvesting and storage, on which our future as a planet may well rest. Another area where greater investment would pay off is in developing new tools to explore and to manipulate the nanoscale world.[13] In all our forward-looking articles, we highlight these challenges and opportunities for the community, and we hope that you will join in these efforts, when you find overlap with your interests, or simply enjoy them, in other cases.

We join you in celebrating this year's Nobel Prizes in Chemistry awarded to our nanoscience colleagues Prof. Jean-Pierre Sauvage of the University of Strasbourg, Prof. Fraser Stoddart of Northwestern University, and Prof. Ben Feringa of the University of Groningen.[14] We wish you a happy, healthy, safe, and productive New Year! We look forward to working with you and to hearing from you in the new year and beyond.

Warren W. C. Chan, Associate Editor



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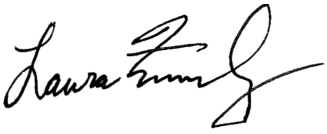

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Notes

Views expressed in this editorial are those of the authors and not necessarily the views of the ACS.

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