Unlocking Doors

We are struck at the seemingly limitless potential of nanoscience and nanotechnology. Unlocking that potential is a result of challenging current ideas, and developing new materials along with new techniques to study them. The beauty all along has been that unlocking each door continues to lead to so many others.

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In her Perspective, Dawn Bonnell describes current techniques to expand the potential of proximal probes to pursue complex properties.[1] When the scanning tunneling microscope and the atomic force microscope were invented in the 1980s,[2,3] these revolutionary techniques enabled significant leaps in new directions, visualizing atoms and molecules. Following the invention of scanning probe microscopies, experiments initially concentrated on obtaining images of the topography and electronic properties of metal and semiconductor surfaces. Then, innovative researchers such as Bonnell extended these techniques to measure local functional and other properties by incorporating new modalities. The Perspective describes original ways in which magnetic and electronic properties have been acquired. These methods have prompted the reinvention of proximal probes each time a new mode or functionality is added or discovered, enabling researchers to investigate materials more deeply.

New materials and assemblies drive the development of new techniques. The discovery of carbon nanotubes led to a surge of research, enhancing our knowledge of their electronic and physical properties, as well as improving our methods for producing cleaner nanotube samples. Applications of nanotubes continue to be proposed and realized. Smalley, Weisman, and co-workers discovered near-infrared fluorescence of nanotubes, which stimulated research in this area with the potential for their use as photostable fluorescent probes.[4] In this issue, Bruce Weisman and co-workers describe an investigation into the dynamics of single-walled carbon nanotubes (SWNTs) using near-infrared fluorescence videomicroscopy.[5] In a related Perspective, Michael Strano and Hong Jin provide an overview of using SWNTs in single-particle tracking studies, discussing the potential of this technique for applications as diverse as biomedical imaging and environmental sensors.[6]

This is just the beginning. Throughout our field and in every issue, we are seeing the creation of new assemblies with precisions that require new structural tools and simultaneous measurements of properties at the nanoscale.[7−9] As a community, we can look forward in anticipation to unlocking many doors, and to discovering ever more beyond.

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REFERENCES AND NOTES

1. Bonnell, D. A. Pushing Resolution Limits of Functional Imaging to Probe Atomic Scale Properties. *ACS Nano* **2008**, *2*, 1753–1759.
2. Binnig, G.; Rohrer, H.; Gerber, C.; Weibel, E. Scanning Tunneling Microscope. *Physica B & C* **1982**, *110*, 2075–2077.
3. Binng, G.; Quate, C. F.; Gerber, C. Atomic Force Microscope. *Phys. Rev. Lett.* **1986**, *56*, 930–933.
4. O'Connell, M. J.; Bachilo, S. M.; Huffman, C. B.; Moore, V. C.; Strano, M. S.; Haroz, E. H.; Rialon, K. L.; Boul, P. J.; Noon, W. H.; Kittrell, C.; *et al.* Band Gap Fluorescence from Individual Single-Walled Carbon Nanotubes. *Science* **2002**, *297*, 593–596.
5. Tsyboulski, D. A.; Bachilo, S. M.; Kolomeisky, A. B.; Weisman, R. B. Translational and Rotational Dynamics of Individual Single-Walled Carbon Nanotubes in Aqueous Suspension. *ACS Nano* **2008**, *2*, 1770–1776.
6. Jin, H.; Strano, M. S. Where is it Heading? Single-Particle Tracking of Single-Walled Carbon Nanotubes. *ACS Nano* **2008**, *2*, 1749–1752.
7. McGuiness, C. L.; Blasini, D.; Masejewski, J. P.; Uppili, S.; Cabarcos, O. M.; Smilgies, D.; Allara, D. L. Molecular Self-Assembly at Bare Semiconductor Surfaces: Characterization of a Homologous Series of n-Alkanethiolate Monolayers on GaAs(001). *ACS Nano* **2007**, *1*, 30–49.
8. Weigelt, S.; Bombis, C.; Busse, C.; Knudsen, M. M.; Gothelf, K. V.; Lægsgaard, E.; Besenbacher, F.; Linderoth, T. R. Molecular Self-Assembly from Building Blocks Synthesized on a Surface in Ultrahigh Vacuum: Kinetic Control and Topo-Chemical Reactions. *ACS Nano* **2008**, *2*, 651–660.
9. Chen, Z.; O'Brien, S. Structure Direction of II−VI Semiconductor Quantum Dot Binary Nanoparticle Superlattices by Tuning Radius Ratio. *ACS Nano* **2008**, *2*, 1219–1229.

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