A MICROSCOPE THAT LOOKS SIDEWAYS

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When most of us use a microscope, we are looking through a specimen, or more and more frequently, at the "top" surface. It usually doesn't occur to us to look sideways. But that is what was done recently in the laboratory of Charles Lieber at Harvard University. As reported by Daniel Frisbie, Lawrence Rozsnyai, Aleksandr Noy, Mark Wrighton, and Prof. Lieber,[2] an atomic force microscope (AFM) was modified to perform as a "chemical force microscope" (CFM). With the CFM they were able to precisely measure adhesive and frictional forces. These forces can be thought of as acting parallel to the surface of the specimen, whereas most observations are made perpendicular to the surface.

They functionalized the tip of an AFM by covalently binding hydrophobic (CH_3) or hydrophilic (COOH) molecules to the tip. It was reasoned that one should be able to predict the friction contrast in images of surfaces patterned with complimentary or noncomplimentary molecules. They constructed monolayers of molecules that terminated in two different functional groups using a lithographic technique. While hydrophobic or hydrophilic molecules were used in these experiments, it was pointed out that the approach can be generalized to other pairs of reactive molecules.

Using a Nanoscope III lateral force microscope, it was demonstrated that the force versus displacement curves were reproducibly larger when COOH was on both the tip and the specimen, smaller when CH_3 was on both, and smallest when the interaction was between CH_3 and COOH. This was interpreted to represent the interaction between hydrophilic groups, which can form hydrogen bonds, is greater than between hydrophobic groups, and interactions between the two different functional groups is weakest. It was calculated that an individual measurement was over an area of about 10 nm^2, representing about 50 functional groups on the sample and tip. Spatial resolution of under 10 nm was predicted.

The potential applications of the CFM are legion. Molecular aspects of adhesion and lubrication, which are poorly understood, can now be examined more closely. In an accompanying article,[3] it was suggested that an array of potential drug molecules could be spread on a surface, then scanned with a tip that had been functionalized with a receptor molecule of interest. The "drug" that had the strongest interaction with the receptor could be quickly revealed.

With the new CFM at our disposal, we will be taking a new look at problems now; a sideways look! ■

1. The author gratefully acknowledges Charles Lieber, Harvard University, for reviewing this article.

2. Frisbie, C.D., L.F. Rozsnyai, A. Noy, M.S. Wrighton, and C.M. Lieber, Functional group imaging by chemical force microscopy, *Science* **265**:2071-2074, 1994.

3. Kaiser, J., A sideways look at chemical activity, *Science* **265**:2010, 1994.

"A LITTLE NONSENSE NOW AND THEN IS RELISHED BY THE WISEST MEN"

Sterling P. Newberry, Consultant

This familiar saying may be a little too risque for sober scientists but surely all of us can accept a substitution of the word humor for the word nonsense. For humor is based on a sense of proportion and fitness of relationships, which is the very essence of the scientific obligation to interpret what we observe. In fact, many of our colleagues insert humorous slides in their very serious talks to help wake up the audience and give them an association for remembering a key point. Do we also remember to use this power of humor when teaching, or otherwise communicating with, a lay audience?

Like it or not we are all required to be teachers to our own circle of support people and should furthermore take advantage of any opportunity to educate the world at large about our work. I should like to give a few examples from my own experience in teaching electron optical practice:

On cleanliness, "Little children who wash their hands on towels, grow up to put their bare hands on clean electron optical parts."

On the importance of vacuum, "Electron Optics and vacuum, one and inseparable, both now and forever."

To help remember the cross over angle of the single potential lens:

> It's 54-40 if you are wanting to fight
> But 54-44 if you would rather be right
> About the field that's presented
> To the electron in its flight
> Through the Einzel Lens center
> From left or from right."

I have observed that many other scientist employ humor to enrich their presentations. Among microscopists, Sara Miller, of Duke Medical center, employs humor brilliantly. As an MSA speaker with the goal of presenting a through over view of the field of "Diagnostic Virology by Electron Microscopy", she has developed the following format. Sara employs two projectors on side by side screens. One carries the outline of her talk interspersed with her serious slides. The other is used to show the audience where the detailed discussion fits into the overall picture or to show a chart or table connected with the item under discussion. With superb timing the second screen suddenly displays a cartoon or photograph which is uproariously funny and is a take off on the technical term or procedure which the audience needs to concentrate upon. Should she lack an appropriate photograph or cartoon by some one like Gary Larson, she photographs a friend or even herself in a charade to form a pun on the word or concept. Before long the audience is sitting on the edge of their seats wondering what is coming next. Sara has taken what could be a very intricate and dull lecture and turned it into a memorable learning experience using materials which any one can readily acquire.

A somber note: I was disappointed to learn that Gary Larson will soon retire from cartooning. Perhaps some of our readers would like to try their hand at scientific cartooning. ■