

Microscopy Reveals Molecular Motion

Stephen W. Carmichael,¹ Mayo Clinic

Microscopes are known for demonstrating structure, but there have been many examples of how this is changing. A novel use of the atomic force microscope (AFM) by Manfred Radmacher, Monika Fritz, Helen Hansma, and Paul Hansma at the University of California, Santa Barbara, has extended the versatility of this instrument even further.² They demonstrated a conformational change in a molecule that happened in a fraction of a second.

Radmacher *et al.* pointed out that enzymes perform their biologic function by undergoing a conformational change and that this change is within the spatial and temporal resolving capabilities of the AFM. They set out to prove this by lowering the tip of the AFM onto lysozyme, a molecule that is roughly egg-shaped, measuring about 4.5 nm by 3 nm by 3 nm. Using the tapping mode in liquid, they found that single molecules exhibited a spike-like height fluctuation when in the presence of a suitable substrate. Absence of substrate or presence of an inhibitor eliminated the fluctuation, leading to the conclusion that the fluctuations are due to enzymatic activity.

In addition, they calculated that the force required to deflect the cantilever 1 nm is 50 piconewtons, corresponding to 2×10^{-20} joules of energy, or about 0.1 eV. The observed height fluctuations lasted about 50 milliseconds, thus giving a rather precise temporal measurement of enzymatic activity.

Radmacher *et al.* cautioned that other physical factors could account for their results, but it is certainly more exciting to think that they have given us a picture of a molecule in motion! If this proves to be true, we can expect more motion pictures of molecular events in the relatively near future. ■

1. The author gratefully acknowledges the help of Dr. Monika Fritz and colleagues at the University of California, Santa Barbara.
2. Radmacher, M., M. Fritz, H. Hansma, and P. Hansma, Direct observations of enzyme activity with the atomic force microscope, *Science* 265:1577-1579, 1994.

Do you know where your x-rays are coming from???

Would you like a software program that makes it fast and easy to see where in your sample the x-ray signal is being generated? Before you do EDS analysis would you like to model your sample and determine the correct conditions to get good data on the first try? Then you need the first Monte Carlo modeling program for Windows and the Mac:

Electron Flight SimulatorTM

- Model any sample chemistry.
- Model any sample tilt and beam kV.
- Model thin films or bulk samples.
- Model a film on a substrate.
- Save models as image files for use in great looking reports.
- A must for analyzing semiconductors and other high performance films.
- The perfect teaching and training tool.
- Unlimited free technical support.
- So simple to use you don't need to read the manual.

If you do x-ray analysis on a SEM or TEM you need Electron Flight Simulator. Call for more information and to request a free demo disk. Take advantage of the special introductory price of only \$495.00

Small World P.O. Box 25284 San Mateo, CA 94402
Phone/Fax (415) 345-8013

Circle Reader Inquiry #9



Happy Thanksgiving

from
VIRTUAL LABORATORIES

offering Diffraction Simulation and Analysis software for the Macintosh®.

Please call for your free demo disk:
tel: 505-828-1640 • fax: 505-822-9759

Circle Reader Inquiry #7

Expand Your Microscopy Horizons

Go digital! Reduce costs, improve quality, and enhance productivity



Digitize images from any SEM or optical microscope. Our integrated system features image enhancement, measurement, annotation, archival, data base management, low cost prints, and more.

2116 B Walsh Ave.
Santa Clara, CA 95050
Tell: (408) 986-0121
Fax: (408) 986-1059



SEMICAPS Inc.

DESKTOP IMAGING FOR MICROSCOPY

Circle Reader Inquiry #11

TRICKS OF THE TRADE

HOW TO KEEP SECTIONS ON GRIDS

To eliminate the problem of the sections falling off, for years we have used "grid glue." Take a 1 inch piece of double sticky tape and put it in 20 ml. of ethylene dichloride. Wait a few minutes until the adhesive comes off and then remove the piece of tape. In a closed bottle this stays good for months. We dip the cleaned grids in the grid glue, let dry and use the grids for picking up sections. We never use formvar coated grids for sections, but always do use grid glue. Prior to use we clean all of our grids in a small amount of acetone in an ultrasonic cleaner for a minute or so. There is some sort of residue on the grids when they are new which is then removed. We have used all EM supply houses, and found cleaning necessary before picking up sections. Actually we clean all of our grids for any use, i.e. whole mounts, or sections. I believe I published this little trick some years ago, 1982 in an SEM paper on mounting materials where we used the grid glue for a different purpose. Hope it works for you also. I should add that we use a variety of resins, so don't think it is resin dependent necessarily. We have used LR White, Embed, the old Epon, Spurr's, Araldite, etc. Good luck!

Judy Murphy, San Joaquin Delta College, Stockton, CA

COMING EVENTS

- ✓ Feb 2/3 '95: **FTIR Microscopy Training Class** (Spectra-Tech). Shelton, CT. Debbie Esposito, Tel.: (800)243-9186, in CT: 926-8998.
- ✓ March 5/10 '95: **PITTCON '95**. New Orleans, LA. (412)825-3220, Fax: (412)825-3224.
- ✓ March 20/24 & 27/31 '95: **Practical Aspects of Scanning Electron Microscopy**. Univ. of MD Short Course. College Park, MD. Tim Maugel, Tel.: (301)405-6898, Fax: (301)314-9358.
- ✓ March 21/24 '95: **Digital Microscopy**
March 28/31 '95: **EELS Imaging & Analysis** (Gatan). Pleasanton, CA. Chris Byrne: (510)463-0200
- ✓ March 28/31 '95: **SCANNING '95**. Monterey, CA. Mary K. Sullivan: (201)818-1010, Fax: (201)818-0086.
- ✓ April 4/7 '95: **Ultramicrotomy in Materials Science**. RMC. Tucson, AZ. Bob Chioveti: Tel.: (602)889-7900, Fax: (602)741-2200.
- ✓ April 4/7 '95: **Expoanalitica + Biociencia** Madrid, Spain. Tel.: +343 423 31 01, Fax: +343 423 63 48.
- ✓ April 18/20 '95: **Focus On Microscopy 95**. Taipei, Taiwan. P.C. Cheng: (716)645-3868.
- ✓ April 24/29 '95: **22nd International Conference on Metallurgical Coatings and Thin Films** (AVS). San Diego, CA. Mary Gray. Tel.: (301)870-8756, Fax: (301)645-1426.
- ✓ May 6/11 '95: **Food Structure Annual Meeting** (Scanning Microscopy International). Houston, TX. Dr. Om Jahari. Tel.: (708)529-6677. Fax: (708)980-6698.
- ✓ May 15/17 '95: **TEM Specimen Preparation** (Gatan). Pleasanton, CA. Chris Byrne: (510)463-0200.
- ✓ May 20/24 '95: **EUCHEM Conference on Electron Microscopy in Solid State Science**. Lund, Sweden. Swedish Nat'l Committee for Chemistry. Tel: +46-(0)8-4115280
- ✓ May 29/June 23 '95: **Introduction to the Meiofauna** (Univ of S. Carolina short course). Gerogetown, SC. Kitty Harper. (803)777-2692
- ✓ June 6/9 '95: **3rd Annual Symposium on AFM & STM** (US Army Natick RD&E Ctr. Natick, MA. Samuel Cohen: (508)651-4578
- ✓ June 7/9 '95: **Confocal Microscopy and Quantitative Image Analysis** (Geo. Washington Univ. 21st Annual Program). Washington, DC. Fred G. Lightfoot (202)994-2882, Fax: (202)994-8885.
- ✓ June 12/22 '95: **Lehigh Microscopy Courses - SEM, X-ray Analysis, AEM, AFM**. Bethlehem, PA. Prof. David B. Williams, Tel.: (610)758-5133, Fax: (610)758-4244.
- ✓ June 26/30 '95: **Computer Simulation and Processing of HRTEM Images**. NCEM, Lawrence Berkeley Lab., Berkeley, CA. Michael A. O'Keefe, eMail: MAOK@LBL.GOV.
- ✓ June 26/30 '95: **11th Annual Short Course on Molecular Microspectroscopy**. Oxford, OH. (513)529-2873
- ✓ June 10/13 '95: **INTER/MICRO '95**. McCrone Research Institute. Chicago, IL. Tel.: 312)842-7100, Fax: (312)842-1078
- ✓ July 10/Aug 4 '95: **Estuarine Fish Ecology** (U. of S. Carolina short course). Georgetown, SC. Kitty Harper: (803)777-2692.
- ✓ August 6/11 '95: **Microbeam Analysis Society (MAS) National Meeting**. Breckenridge, CO. Gregory Meeker, Tel.: (303)236-1081, Fax: (303)236-1414.
- ✓ August 13/17 '95: **Microscopy Society of America/Histochemical Society Annual Meeting**. Kansas City, MO. (800)538-3672, Fax: (508)548-9053.
- ✓ Oct. 12/14 '95: **GLEMA '95**. Toledo, OH. Carol A. Heckman, Tel.: (419)372-2432

PAYING A LOT OF MONEY AND NOBODY'S PAYING ATTENTION?

Service Contracts are expensive. Are you getting the service you paid for?
Call the Materials Analytical Services' EM SERVICE GROUP
before you sign another Service Contract.

TEM'S/SEM'S

AMRAY
TOPCON
ISI
CAMBRIDGE
ZIESS

ULTRAMICROTOMES

DUPONT	RMC
MT-1	MT-5000
MT-2	MT-6000
MT-2B	MT-7000
MT-2C	CRYO

PREP EQUIPMENT

VACUUM COATERS
SPUTTER COATERS
MECHANICAL PUMPS
TURBO PUMPS
PLASMA ASHERS

WE SERVICE

COMPUTER CONTROLLERS
X-RAY SPECTROMETERS
BEAM BLANKERS
WATER CHILLERS

Contracts and On-Demand
Emergency Service at
Reasonable Rates from
Factory Trained Personnel.
In the Southeast Call:

1-800-421-8451

**MATERIALS
ANALYTICAL
SERVICES**

ADVANCED ANALYTICAL PRODUCTS AND SERVICES

3597 Parkway Lane • Suite 250 • Norcross, Georgia 30092 • 404-448-3200 • FAX 404-368-8256 or
616 Hutton Street • Suite 101 • Raleigh, North Carolina 27606 • 919-829-7041 • FAX 919-829-5518