Frank DiMeo

THREE COMPANIES WITH CHESS ROOTS

Multiwire, MiTeGen, and Advanced Design Consulting U.S.A.

Multiwire Laboratories, Ltd.

Multiwire's president, Donald Bilderback, CHESS/Applied and Engineering Physics, is a true x-ray veteran and a true Cornell veteran. Since 1981 his company has been developing and manufacturing products for rapid x-ray orientation of single crystals using the Laue back-reflection method. "Rapid" is the key word for making his product line a success. Utilizing a real-time large-area x-ray detector, motorized orientation stages, and computer analysis of back-reflection images, the orientation of a variety of crystal materials, such as silicon, gallium arsenide, sapphire, geological minerals, and turbine blade materials can be determined in near–real-time—a few moments.

CRYSTAL ORIENTATION MAY SOUND ESOTERIC, BUT INDUSTRIAL AND ACADEMIC CUSTOMERS' DEMAND FOR IT IS GROWING DAILY.

Crystal orientation may sound esoteric, but industrial and academic customers' demand for it is growing daily. Although new materials are often the basis for high technology products, many applications are extremely specific about the quality and orientation of crystalline materials. In some cases, single crystal materials are needed, and in a growing number of technological products the exact crystal orientation is crucial to device function. Bilderback gives synthetic sapphire as an example. Extremely hard and of high crystalline quality, synthetic sapphire is an excellent material for manufacturing surgical scalpels and other microblades. Cutting edges can be as thin as 40 to 50 nanometers, which is crucial in detailed surgery on small tissues, such as ophthalmology, neurosurgery and cosmetology. Many processes in semiconductor fabrication also rely on the orientation of the crystal substrate. Chemical etching, plasma processing, deposition and growth of overlayers, and damage by electromigration are examples requiring exact crystal orientation to produce a working device.

The impetus for the original multiwire proportional area counter was to create an "electronic film plate" that bypassed the drudgery of exposing and developing multiple Polaroid film images—all part of the iterative process of orienting crystals using x-ray laboratory sources. Cornell and NSF played crucial roles in the early development of the first prototype wire detector. In the late 1970s, Bilderback and Margaret Rich (now company vice president), working in the x-ray characterization facility in Cornell's Materials Science and Engineering Department, built the first detector to help Stephen Sass, Materials Science and Engineering, image grain boundaries in metallurgical materials. Bilderback now notes with pride that so much of the work with x-ray diffraction patterns, which include the landmark research by Von Laue that garnered him the 1912 Nobel Prize in Physics, can be done with the flip of a switch using a modern Multiwire system.

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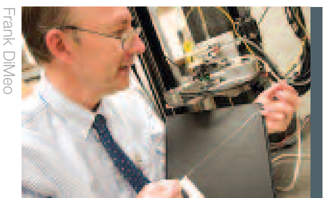

Donald Bilderback

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"MITEGEN [WAS] FOUNDED TO DEVELOP AND MANUFACTURE PRODUCTS FOR THE SMALL MOLECULE AND MACROMOLECULAR CRYSTALLOGRAPHY COMMUNITIES."

MiTeGen, LLC

The 2004 start-up MiTeGen epitomizes the benefits that Cornellians derive from a campus that intentionally blurs the boundaries between scientific disciplines. A company statement affirms, "MiTeGen [was] founded to develop and manufacture products for the small molecule and macromolecular crystallography communities. Our strength and focus is on applying concepts and technologies from physics and related fields to address the practical problems faced by our friends and collaborators in the structural biology community."

Provided

Robert Thorne

Physics professor Robert E. Thorne, company founder and president, is referring to biologists whose goals are to understand the molecular structures responsible for living matter. The structural biologist's craft involves isolating protein molecules, then doggedly using a variety of experimental tools—most commonly x-ray diffraction—to produce three-dimensional models with astounding atomic resolution. Complex and beautiful images of protein molecules have become commonplace on scientific journal covers. The inside stories usually reveal new insights that the atomic structures lend to living matter, function, or diseases.

Complex and beautiful images of protein molecules have become commonplace on scientific journal covers. The inside stories usually reveal new insights that the atomic structures lend to living matter, function, or diseases.

Endemic in the field, however, are difficulties in handling soft, water-saturated, jello-like protein specimens and preventing them from being damaged by powerful x-ray beams provided by synchrotron sources like CHESS. Thorne entered the discipline with a physicist's background in crystal lattices and dynamics, aiming to understand issues related to protein crystal quality, defects, and damage. As his group gained experience in handling protein specimens, they developed better ways to scoop water droplets and hold the fragile crystals, which are usually no larger than a 10th of a millimeter. The collective expertise of a bevy of graduate and undergraduate students, NSF Research Experience for Undergraduates (REU) visitors, postdocs, and staff at MacCHESS came together to design and microfabricate a remarkably innovative protein-handling device called a MicroMount™. It consists of an ultrathin material with channels and holes. By itself, it would be too flexible to serve as a mount, so they cleverly wrap the sheet around a circular post to gain the rigidity of a cylindrical tube. These and other subsequent microfab products are generating a flutter of interest among researchers dealing with microscopic or delicate crystals.

THE STRUCTURAL BIOLOGIST'S CRAFT INVOLVES ISOLATING PROTEIN MOLECULES, THEN DOGGEDLY USING A VARIETY OF EXPERIMENTAL TOOLS—MOST COMMONLY X-RAY DIFFRACTION—TO PRODUCE THREE-DIMENSIONAL MODELS WITH ASTOUNDING ATOMIC RESOLUTION.

The "spark" that caused Thorne to start MiTeGen was frustration in wasting a good year trying to get other companies to license and produce his useful invention. He is very happy with the role Cornell has played, both in defending the intellectual property and in encouraging him and providing extensive advice about how to set up the company. He urges on others thinking about starting a company: "If you've got something you're confident will sell and cash you can afford to lose, just do it!"

Advanced Design Consulting USA, Inc.

If the person on the street hears that Lansing's Advanced Design Consulting USA is an "engineering and scientific consulting firm providing solutions to complex problems," the imagination would have to be tremendous to guess the broad range of technologies that this 35-person company develops for a worldwide market. A quick look at the company's website shows its interpretation of "engineering the future." Using microelectromechanical systems (MEMS) technology, the company has produced unique miniature remote monitoring systems for a number of applications, such as measuring the initial strength and service life of concrete in roadways and bridges, ocean temperature and depth monitoring, and smart battery sensors that can characterize the important properties of commercial and military vehicle batteries. Contracts with the military have introduced numerous new technologies for field service, including shot counters, hot gun barrel detectors, roll-on–roll-off portable bridges, synthetic rope that is lightweight and saltwater-resistant, counter shooters, and covert radiation monitors. ADC has a track record of developing new products for many government science and military organizations and has a solid patent portfolio, as a result.

ADC COLLABORATED WITH CHESS SCIENTISTS TO DEVELOP A STATE-OF-THE-ART ADJUSTABLE X-RAY SLIT SYSTEM.

Company president Alex Deyhim attests that this record of success is firmly rooted in working with Cornell faculty, utilizing Cornell facilities, and collaborating on joint projects. Deyhim's education includes engineering as an undergraduate and business at Cornell's Johnson Graduate School of Management, as well as work experience at CHESS and managing the Cornell electronics packaging facility. This background gives Deyhim a perspective to bridge the gulf between the needs of customers and the creativity of a major research university like Cornell. In addition, ADC boasts a scientific advisory board filled with Cornell faculty, lab directors, and industry and NASA leaders.

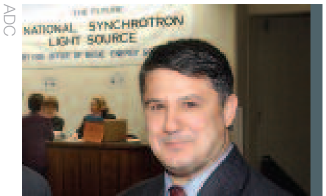
ADC

ADC

ADC collaborated with CHESS scientists to develop a state-of-the-art adjustable x-ray slit system. The stringent requirements of small-angle x-ray experiments set the production standard, while instruction and feedback from CHESS on the polishing process for the slit edge proved valuable. ADC now has five distinct models and has sold units to synchrotron facilities around the world. Deyhim adds that each small example like this results in increased sales and the creation of good manufacturing jobs in our community.

Ernest Fontes
Assistant Director, CHESS

ADC



Alex Deyhim

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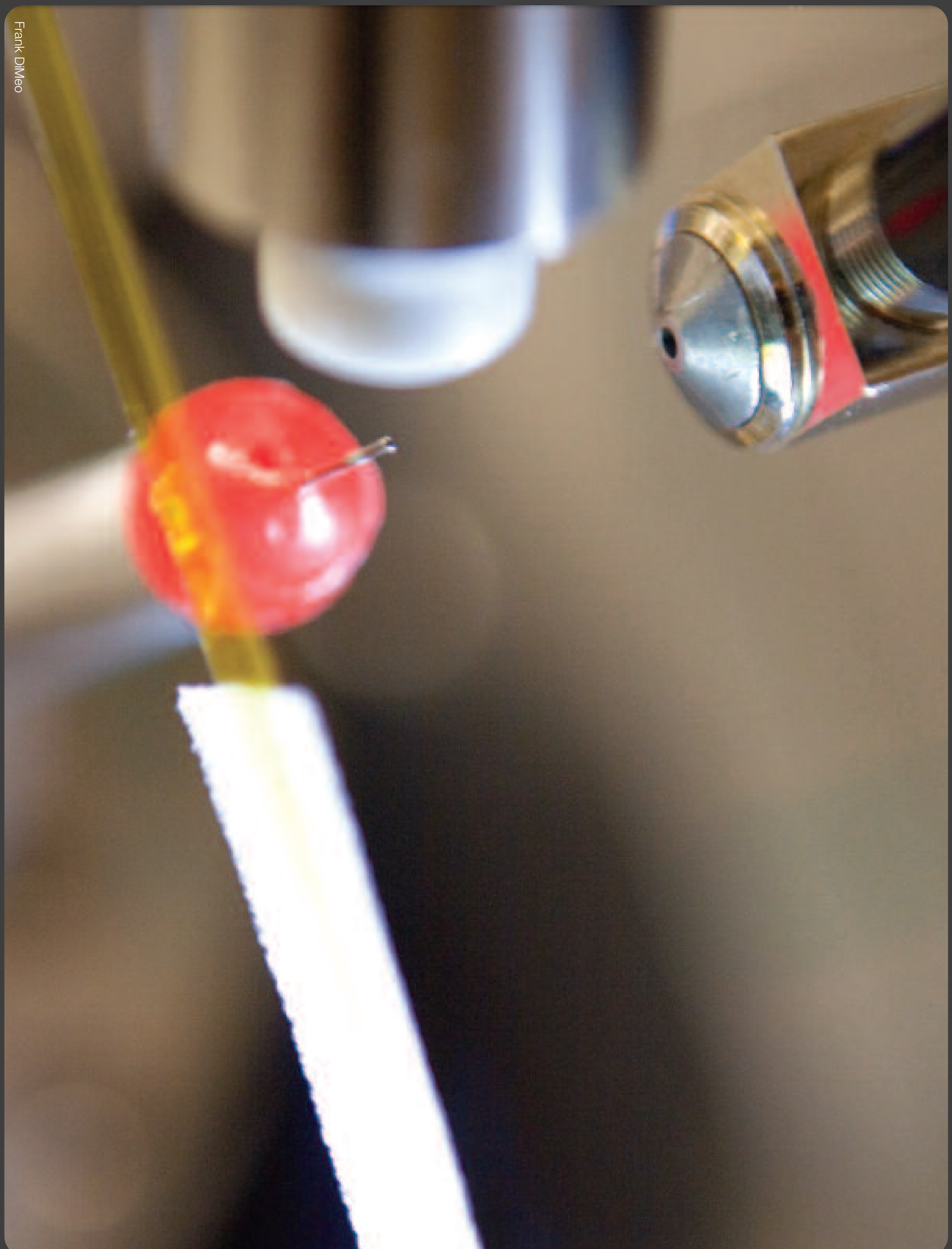
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