

Kotov and Kim chiefly see their stretchable conductors as implantable electrodes although other applications are also being developed. Rigid electrodes create scar tissue that prevents the electrode from working over time, but electrodes that move like brain tissue,

for example, could avoid damaging cells, Kotov said. These electrodes could also be used in displays that can roll up or in the joints of lifelike “soft” robots.

Because the chain-forming tendency of nanoparticles is so universal many other materials could stretch, such as

semiconductors. In addition to serving as flexible transistors for computing, elastic semiconductors may extend the lives of lithium-ion batteries. Kotov’s team is exploring various nanoparticle fillers for stretchable electronics, including less expensive metals and semiconductors.

## In Memoriam

### James W. Mayer



**James W. Mayer**, a pioneer in the application of ion beams to materials science, passed away on June 14, 2013, in Kailua-Kona, Hawaii. Jim was one of the most innovative and out-of-the-box thinkers imaginable, and for six decades he literally defined the field of how energetic ions could be used to advance materials science. He earned his PhD degree from Purdue University in physics, and worked at Hughes Research Lab before going to the California Institute of Technology in 1967 as a professor of electrical engineering. In 1980, he joined Cornell University as the Francis Norwood Bard Professor of Materials Science and Engineering, becoming director of the Microscience and Technology Program in 1989. In 1992, Jim joined the faculty at Arizona State University (ASU) where he served as director of the Center for Solid State Science, subsequently becoming a Regents Professor (1994) and P.V. Galvin Professor of Science & Engineering (1997).

Mayer was a Fellow of the American Physical Society and the Institute of Elec-

trical and Electronic Engineers. In 1981, he received the Von Hippel Award, the highest honor bestowed by the Materials Research Society, for having “carried out research on implantation that identified the damage and the epitaxial regrowth phenomena crucial to the semiconductor industry, and pioneered the use of ion beam techniques for materials analysis.” Three years later Jim was elected to the National Academy of Engineering.

Among Jim Mayer’s many accomplishments, three stand out as exceptional scientific and technological advances. In the 1950s, he played a critical role in the development of semiconductor detectors to measure the energy of energetic particles and ionizing radiation. Second, he was pivotal in the creation of the field of ion-beam analysis, often referred to as Rutherford backscattering spectrometry (RBS), as a major analytical tool for materials science. He used RBS to define many of the advances in thin-film science of the 1970s and 1980s, including thin-film reactions and kinetics, solid-phase regrowth of semiconductors, ion-beam mixing for the formation of metastable alloys, implantation disorder and impurity location in semiconductors, and the study of metal silicides and dielectric films. His third major contribution was the development of ion implantation to electrically dope silicon. Using RBS and ion channeling, Jim discovered the key annealing steps to remove implantation disorder and activate implanted dopant atoms, making ion implantation a practical tool. The importance is summed up by the story of the 1970 plenary speech at the first international conference on ion implantation by an electronics industry head who firmly predicted that implantation would never be used in the electronics industry. One year later implantation

was on the production floor of every major semiconductor house, enabling low power complementary metal oxide semiconductor integrated circuits and the myriad of computer and communication applications that followed.

As equally amazing as his scientific accomplishments was Jim Mayer’s mentoring and dedication to helping others. He guided more than 40 graduate students. He had a steady stream of visiting scientists from around the world in his laboratory, creating an “extended family” of lifelong friends. Jim had an encyclopedic memory for what was published in the field and would admonish those around him to “never forget your own data.” It has been said that people did their very best work when they were with Jim. His enthusiasm, dedication, and quiet encouragement swept everyone in. He remained a longtime career mentor to many, quietly helping them behind the scenes.

Jim was a dedicated teacher and a Renaissance man. He was an aficionado of art, cinema, and good books. He had a rare sense of humor, and students and colleagues alike loved hanging out with him. At Caltech he became a scuba diving instructor for students. Noting the dearth of recognition available to colleagues working at the interface between energetic ions and materials science, he simply created his own Böhmsche Physical Society, which recognized achievements and hosted enormously popular beer and wine evenings at ion-beam meetings. At Cornell, Jim developed a course on the science of art, using ion beams to analyze paint pigments and inks. He published two books on the topic and was invited to lecture conservators at the Louvre museum in Paris. At ASU he created a popular “Patterns in Nature” course for



undergraduates. He then developed an online version for teachers and created an ASU PIN Van, a science laboratory on wheels with state-of-the-art microscopes that was driven to K–12 schools throughout the state to provide young students with an introduction to materials science.

Jim authored and co-authored more than 750 papers, 12 books, 12 patents, and received over 17,000 citations (ISI listed Jim as one of the 1000 most-cited

Contemporary Scientists between 1965 and 1978). He always had a pad of paper and pen on his desk with the next book or paper underway. Once in 1968, at Chalk River Nuclear Labs in Canada, he was particularly excited about the new implantation annealing data he had just collected. That evening he broke out his pad and pen, and by the next morning he had a complete Applied Physics Letter drafted and ready for the typist.

Jim retired to Hawaii several years ago. Last year his former students and colleagues gathered to hold a science fest for him as Jim and his wife, Betty, celebrated their 60th wedding anniversary. Jim is survived by Betty, four children, seven grandchildren, four great-grandchildren, and by many, many grateful people who he helped to become successful scientists, teachers, and lovers of life.

**Tom Picraux and Mike Nastasi**

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- RR Solution Synthesis of Inorganic Functional Materials
- SS Nanocrystal Growth via Oriented Attachment and Mesocrystal Formation
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