



We're History

Biopolymer Innovator Uses ChE to Advance Medicine

In 1977, polymers were John Travolta's disco wardrobe and the seats of Checker Marathon taxicabs. In fact, biomedical application of polymers meant putting a BandAid on a cut. Also in 1977, Robert S. Langer joined the faculty of the Massachusetts Institute of Technology (MIT). Biomedical polymer engineering opened a new chapter when Langer focused on this emerging field.

A chemical engineer by training — both undergraduate and doctoral degrees in the field — Langer followed graduate school with a two-year post-doc in a surgical laboratory. Langer saw that materials science played virtually no role in the medical technology of the time, and that polymer engineering offered the possibility of great advances in the treatment of disease and injury.

His first innovation was contact delivery of drugs through the skin — the epidermal patches used to deliver nitroglycerin safely to heart patients, Norplant patches and many other applications. Langer described the development of surface-eroding polymers for drug delivery. In particular, he described a copolymer that allowed delivery rates from days to years, depending on the proportion of monomers used.

Part of Langer's work is, in his own words, the quest to "create better materials for medicine. I thought materials in medicine came through materials science. Wrong. Doctors found things around their house that seemed to fit the application."

He gave several examples, including sausage casing for dialysis tubing, mattress stuffing for breast implants, and ladies girdles for the artificial heart. The polyether urethane that flexed and retained its shape in girdles seemed an ideal material for artificial hearts in terms of service life. "The problem," Langer said, "is that the material was not good for blood flow, and occasionally caused clotting that often led to fatal strokes."

In the 25 years that followed, Langer has become a preeminent leader in the field of biomedical engineering. His discoveries are at the heart of today's multibillion-dollar controlled drug delivery industry and have provided a framework for the emerging technology of tissue engineering.

Langer's groundbreaking research in polymers dispelled the belief that slow delivery was possible only for

small molecules. His later work contributed to the application of several novel biodegradable polymers to medicine.

A procedure worked out with one of these polymers became the first FDA-approved treatment for brain cancer in 20 years and the first polymer-based treatment to deliver chemotherapy directly to a tumor site. This treatment has far fewer side effects than conventional chemotherapy and has extended the lives of numerous patients.

Langer's current work includes designing aerosol drug-delivery systems that greatly increase the effectiveness of current systems. "The best aerosols now only achieve efficiencies up to 4%. By redesigning the aerosol molecule, we are moving toward efficient, non-invasive aerosol delivery of a wide range of drugs," Langer said.

Langer has received numerous major awards. In 1989, he was elected to the Institute of Medicine of the National Academy of Sciences, and in 1992, he was elected to both the National Academy of Engineering and the National Academy of Sciences. He is the only person to hold membership in all three of these academies at this time. He also chairs the U.S. FDA's Science Board, the FDA's highest advisory board, and holds 362 patents. In

2002, Langer received the Othmer Gold Medal from Chemical Heritage Foundation (CHF). The Othmer Gold Medal is co-sponsored by CHF and four affiliated organizations: the American Chemical Society (ACS), the American Institute of Chemical Engineers (AIChE), the Chemists' Club, and the Société de Chimie Industrielle (American Section).

Both Forbes Magazine and BioWorld have named Langer one of the world's twenty-five most important individuals in biotechnology. Langer is the Kenneth J. Germeshausen Professor of Chemical and Biomedical Engineering at MIT. He was born in Albany, NY, and received his bachelor's degree from Cornell Univ. and his Sc.D. from MIT, both in chemical engineering.



Robert S. Langer — a preeminent figure in the application of biotechnology in medicine

"We're History" is prepared by the Chemical Heritage Foundation (CHF; www.chemheritage.org). This article is based on a presentation given by Robert Langer when he received the 2002 Othmer Gold Medal.