

## Dr. Robert Langer is nominated for Controlled-Release drug delivery systems

---

### What is it that this person (or these people) have done that is a ground-breaking innovation in engineering?

Dr. Langer was the first to synthesize new materials and engineer them to create polymeric controlled release systems that can deliver therapeutically important macromolecules to humans.

As former Nature editor, Phillip Ball, wrote (*Made to Measure: New Materials for the 21st Century*) “It was widely believed at first that polymer delivery systems would not be equal to this task...But in 1976, Robert Langer and colleagues found that certain polymers, generally ones that were highly hydrophobic (water-repellent) such as copolymers of ethylene and vinyl acetate, could be mixed with powdered proteins and formed into microspheres that would release the proteins at a steady, slow rate, persisting sometimes for up to one hundred days.”

Robert Langer’s inventions and discoveries have been translated (often by Langer himself) to many products that have profoundly impacted human health. When Dr. Langer won the Millennium Prize, the prize committee estimated that a 100 Million people had directly benefited from Langer’s inventions. It is likely that the number of patients that will potentially be treated using technologies invented in Dr. Langer’s laboratory will exceed 1 billion.

Dr. Langer helped create two new fields at the intersection of engineering and medicine: 1] controlled release materials for drug delivery and 2] Tissue Engineering. Langer’s founding role in these fields has been eloquently described by others in *Nature* 458, 22-24 (2009). In each of these fields, Langer published the first seminal papers describing successes. Equally importantly, he followed up by developing a detailed scientific understanding of each class of phenomena. This mechanistic understanding provided the principles that have made possible the systematic translation of inventions to useful products.

A large number of scientists around the world have followed in Langer’s footsteps to create new drug delivery materials or advance tissue engineering – none bring together the unique combination of superb engineering and science that characterizes Langer’s profound contributions.

## **In what way has this innovation been of global benefit to humanity?**

Improving human health and developing therapies to prevent and cure illnesses has been an important priority since human civilization began. Dr. Langer has created two engineering fields that have profoundly impacted the well-being of mankind: controlled release systems for delivery of therapeutics (with Folkman), and tissue engineering (with Vacanti).

Controlled release technologies have revolutionized the delivery of medicine. An early application of controlled release technology is polymer microspheres which continuously delivers nanopptide LHRH analogs for up to 4 months and are now widely used to treat prostate cancer and endometriosis. Similar materials have led to better treatments for schizophrenia, alcoholism, narcotic addiction and other mental health diseases. Dr. Langer's development of a polyanhydride wafer mixed with a chemotherapeutic drug that delivers therapeutics after surgery at the sight of malignant brain tumors has extended the life of numerous patients.

Materials developed by Dr. Langer are also important for the delivery of vaccines against viruses that mutate rapidly, and for delivery of gene therapies. He has also developed microchips which can be controlled externally to deliver drugs remotely depending upon the health of the patient. This new technology will impact the delivery of personalized health care. Drs. Langer and Vacanti created a field of tissue engineering by being the first to make synthetic polymers that deliver cells to form specific tissue structures. This concept led to the development of a new kind of artificial skin using Dr. Langer's polymer, which is now FDA approved for burn victims.

Tissue engineering (part of regenerative medicine) is now a vigorous research field all over the world as engineers and clinicians work toward developing artificial tissues and organs that could save innumerable lives.

In addition to the profound impact of the engineering advances made by Dr. Langer on improving the human condition, he has mentored over 250 young engineers who are faculty members in major universities throughout the world (13 have been elected to the National Academy of Engineering or the Royal Academy of Engineering). Rarely does one person play a key role in developing two different engineering fields that have profoundly impacted the human condition. Dr. Langer is such an engineer.

**Is there anyone else who might claim to have had a pivotal role in this development?**

Dr. Folkman was Dr. Langer's postdoctoral mentor and he coauthored the first paper with Dr. Langer on controlled release of macromolecules (Nature, 1976). Dr. Vacanti and Dr. Langer coauthored the first papers on 3 dimensional tissue engineering (J. Ped Surg., 1988; Science, 1993). It is understood that Dr. Langer provided the engineering creativity for both inventions. Both Drs. Folkman and Vacanti are outstanding surgeons and scientists, but not engineers.

Dr Langer's essential role in creating the fields of controlled release of drugs and tissue engineering are attested to by recognition with many prizes including the Albany Medical Prize, Draper Prize, Millennium Technology Prize, the National Medal of Science (US), the National Medal of Technology and Innovation (US), the Breakthrough Prize in the Life Sciences and the Dan David Prize, alone.

**Other comments**

Dr. Langer has published 1258 papers, has 1,050 issued and pending patents, and has been involved in starting 27 companies. His H index is now 155, and his papers have been cited over 100,000 times.