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Robert Langer is one of 9 Institute Professors at MIT; being an Institute Professor is MIT's highest honor. His articles have been cited over 474,000 times; his h-index of 337 is the highest of any engineer in history. His patents have licensed or sublicensed to over 400 companies; he is a cofounder of many companies including Moderna. He holds 45 honorary doctorates and has received over 220 awards, including both the United States National Medals of Science and Technology & Innovation (one of 3 living individuals to have received both honors), and has been elected to the National Academies of

Medicine, Engineering, Sciences, and Inventors.

Abstract: “A Road Not Taken: My Path from Chemical Engineering to Nanotechnology and Medicine”

Research in my laboratory has focused on the synthesis and development of materials with tailored chemical properties, particularly those that can impact human health by controlling the release of therapeutic macromolecules through materials, as well as designing new tissues and organs. When we started our investigations, it was believed that only low-molecular-weight compounds – but not peptides, proteins, or nucleic acids – could be slowly released from polymer systems. However, we developed chemical systems that showed otherwise, laying a foundation for the effective use of many bioactive molecules. In addition, prior to our research, scientists used “off the shelf” materials to address a biological or medical problem, even though the materials were not designed for that purpose, e.g. materials used for artificial hearts were derived from ladies’ girdles because of their flexural properties. In contrast, we proposed a framework for biomaterials synthesis by asking what the important qualities are from a chemistry, biology, and engineering standpoint and synthesized new materials for specific purposes. For example, in controlled release, we synthesized polyanhydrides that display surface erosion, a property which can protect unstable molecules, as well as prevent large amounts of drug from being released at once. We also synthesized long-circulating nanoparticles, helping pave the way for nanomedicine-based drug delivery, and developed approaches for combinatorial lipid synthesis for lipid nanoparticles. These made possible the delivery of RNA-based therapeutics and vaccines, helping both Moderna and Alnylam create life-saving products. Finally, we synthesized polymer systems to deliver cells to form specific tissue structures, permitting the creation of skin, e.g. for burn victims, and new blood vessels to heal wounded soldiers in Ukraine. These findings also led to organs on a chip, now an FDA priority.