Matthew Tirrell

Founding Pritzker Director and Dean
Deputy Laboratory Director for Science, Argonne National Laboratory

Areas of Research Expertise

Biomolecular engineering, nanotechnology, polymer properties

Research Overview: Tirrell Group

The Tirrell laboratory has broad and deep expertise in creating novel, functional self-assembled structures focusing on tailored nanomaterials for basic science research, as well as diagnostic and therapeutic applications.

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Research

Matthew Tirrell is a pioneering researcher in the fields of biomolecular engineering and nanotechnology.

He specializes in the manipulation and measurement of the surface properties of polymers, materials that consist of long, flexible chain molecules. Tirrell's team has provided new insight into polymer surface phenomena, such as adhesion, friction, and biocompatibility.

Tirrell's work combines microscopic measurements of intermolecular forces with the creation of new structures based on self-assembly of synthetic and bioinspired materials.

His contributions to the understanding of peptide amphiphile have led to conjugating peptides to lipids in order to use the self-assembly character of lipids to direct a controlled presentation of peptides. Tirrell's current work in peptide amphiphile micelles demonstrates they are versatile, modular, biofunctional nanoparticles that can be injected into the circulation to target, image and, in some cases, treat pathological conditions. The Tirrell group has active work now in using such particles to diagnose and treat atherosclerosis, and also to stimulate the adaptive immune system to generate desired B-cell and T-cell responses.

New areas of inquiry within the Tirrell group explore the generation of new materials and functional assemblies via polyelectrolyte complexation. Under the right conditions, oppositely charged polyelectrolyte chains can assemble into flexible, fluid complexes. Such fluids (sometimes known as coacervates) have very low interfacial tension with water so they are very useful as encapsulants and also as agents to drive self-assembly in aqueous systems. Tirrell's research group has been exploring these materials and assemblies in a variety of biomedical applications such as micelle formation, encapsulation and hydrogel formation.

Bio

Tirrell is the Founding Pritzker Director and Dean of IME, and Deputy Laboratory Director for Science at Argonne National Laboratory.

Before becoming founding director of the IME in 2011, Tirrell served as the Arnold and Barbara Silverman Professor and chair of the Department of Bioengineering at the University of California, Berkeley, and as professor of materials science and engineering and chemical engineering and faculty scientist at Lawrence Berkeley National Laboratory. Prior to that, he was dean of engineering at the University of California, Santa Barbara for 10 years. Tirrell began his academic career at the University of Minnesota as an assistant professor in the Department of Chemical and Materials Engineering and later became head of the department. He received his BS in chemical engineering from Northwestern University and his PhD in polymer science and engineering from the University of Massachusetts.

Tirrell has received many honors, including the Polymer Physics Prize of the American Physical Society, the Chevalier dans l'Ordre des Palmes Académiques (*Ministry of Education of France, "pour services rendus à la culture française"*), the William H. Walker Award from the American Institute of Chemical Engineers, and the Charles M. A. Stine Award, and the Professional Progress Award from the American Institute of Chemical Engineers.

He is a member of the National Academy of Engineering, the American Academy of Arts and Sciences, Indian National Academy of Engineering and the National Academy of Engineering. He is a fellow of the American Association for the Advancement of Science, and the American Institute of Medical and Biological Engineering.