INDUSTRIAL PARTNERSHIP
FOR RESEARCH IN
INTERFACIAL AND MATERIALS ENGINEERING

Coating Process Fundamentals Program

Coatings, films, membranes, and interlayers are everywhere. They are commonly made by depositing liquid layers of polymer solution or particulate suspensions, which are then "cured" or solidified by drying, polymerizing, or cross-linking. The solidified layer is a functional coating with microstructure and properties that are essential to its use. Alternatively, the layer can be stripped off the substrate to make a free standing film that functions on its own as a membrane or layer in a laminated structure such as a fuel cell or membrane.

Such materials are vital ingredients of an enormous diversity of products from adhesives, coated papers and fabrics, and pre-coated steel and aluminum, to separation membranes, photographic film, magnetic tapes, integrated circuits and light-emitting diode displays. Mass-produced polymer electronics on flexible substrates or "rolltronics" are on the horizon.

The key technological challenges are to achieve the desired functions of the coating, which may be electrical, optical, photochemical, permselective, catalytic or adhesive, through control of the interfaces and microstructures. This must be commensurate with industrial requirements of a reproducibly uniform or patterned product and, most often, a continuous, high-throughput, efficient manufacturing process capable of rapid changeover. Therefore, one focus of this research program is to deliver, through scientific understanding of liquid flow coating, solidification, and microstructure development, the optimum process conditions for identified industrial needs. The avenues for this work include new processes for advanced materials systems, more efficient processes, improved product quality, and in-line measurement and process control.

A cross-disciplinary approach to the basic challenges facing coating processes is inherently necessary. The Coating Process Fundamentals Program is unique in its comprehension and depth of inquiry. The program draws from extensive input from industry and the expertise of researchers in fluid mechanics, optics, elastohydrodynamics, rheology, transport and reaction phenomena, stress and failure analysis, colloid and interface science, microstructure characterization, polymer science and engineering, ceramic science and engineering, applied mathematics, and scientific computation. Individual researchers work in several disciplines themselves as well as collaborate across disciplines. This environment of scientific and technological challenges coupled with industrial interactions has proved superb for educating research students and getting them and their results into applications.

Principal Investigators and their primary areas of expertise:

Lorraine Francis (Co-Program Leader)	Ceramics, Polymer/Ceramic Composites, Microstructure, Stress and Properties of Coatings
Satish Kumar (Co-Program Leader)	Stability, Dynamics, Manipulation of Interfaces, Transport Processes in Microscale Systems
Marcio Carvalho (PUC-Rio)	Fluid Mechanics, Rheology, Transport Phenomena, Drying
Alon McCormick	Curing, Thermodynamics and Kinetics, NMR
C. Daniel Frisbie	Molecular materials and interfaces, organic semiconductors, molecular electronics, atomic force microscopy
Michael Tsapatsis	Materials Synthesis, Structure Elucidation and Modification

Associated Investigators: Chris W. Macosko and W. "Bill" Gerberich

Contact Bob Lewis, Director of Technology Transfer, at 612.625.1269 or boblewis@umn.edu to learn more about the Coating Process Fundamentals research and IPRIME.
Visit the CPFP Website at www.cems.umn.edu/research/cpfp and the IPRIME website at www.iprime.umn.edu

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