Anne Mayes Named Outstanding Young Investigator for Work on Macromolecules

Anne Mayes is the 1998 recipient of the Materials Research Society's Outstanding Young Investigator Award. The Massachusetts Institute of Technology professor is cited "for incisive theoretical and experimental investigations of macromolecules at and near surfaces and interfaces leading to tailorable surface properties, especially novel biocompatible substrates."

The Outstanding Young Investigator Award recognizes exceptional, interdisciplinary scientific work in materials research by a young scientist or engineer who also displays leadership in the materials area.

Mayes's work includes a theoretical understanding of the role of molecular architecture on surface segregation in polymer blends, and the influence of confinement of block copolymers in thin layers on their structure and orientation, as well as applications of block copolymers for solid polymer electrolyte batteries, and novel branched copolymers for improved biocompatibility of polymer surfaces. Her combination of synthesis and characterization skills, along with theoretical investigations, have enabled groundbreaking work in a number of areas.

She was the first to identify the potential use of branched additive segregation to modify polymer surfaces via self-consistent mean-field calculations, and then to test these predictions via synthesis of selectively deuterated model branched polymers followed by neutron reflectivity measurements to depth profile the near-surface polymer structure. Her experiments confirmed early theoretical insights, and have opened a new area of polymer research.

She has used this new approach to selectively and rationally design surfaces for a variety of applications, including the creation of surfaces with enhanced water wetability and the development of novel biocompatible surfaces. In the latter case, she has developed a systematic approach to tailor polymer surfaces for biomaterials applications, including attention to the important problem of controlling nonspecific protein binding to polymer surfaces.

In another project, she is collaboratively developing a new dynamic x-ray scattering technique using the high brightness synchrotron source at Argonne National Laboratory to study molecular motions of polymer chains at the radius of gyration length scale. This technique will complement the traditional dynamic light scattering and spin-echo neutron scattering measurements that can probe polymer dynamics on other length scales.

Mayes's work spans the range of basic theory, materials synthesis, and experimentation. She has described self-consistent mean-field calculations showing that branched chains are driven to segregate to surfaces by the greater configurational entropy afforded the branches there. She has also applied these theoretical principles to create protein-resistant surfaces by segregation of random copolymers containing oligoethylene oxide branches to the surface of (slightly) lower surface energy polymethylmethacrylate. That segregation occurred was proven by detailed and elegant neutron reflectivity experiments and further buttressed by contact angle measurements. Adsorption of bovine and human serum albumen and equine cytochrome c was inhibited by the surface segregation of the random copolymer.

Mayes has explored the factors that control the morphology of a thin film of a lamellar block copolymer frustrated by being confined to a uniform layer thickness incommensurate with its optimum bulk lamellar period. She showed that if the surface energy penalty is not too large, the block copolymer lamellae will orient normal to the film plane rather than adopt a lamellar period much larger or less than the natural period. In tuning the surface energy difference, Mayes used thin random copolymer layers to define the two block copolymer surfaces, tailoring the composition of the random copolymer to demonstrate the concept.

In the process of proving that the lamellae were oriented perpendicular to the film plane, she and her collaborators showed that it was possible to use small angle neutron scattering (SANS) to determine the in-plane structure of a polymer film as thin as 80 nm. The conventional wisdom is that a sample of 1 mm is necessary to have sufficient scattered intensity, but Mayes and co-workers showed that with the right neutron source and detector, SANS can yield valuable information on sub-100 nm films. This work opens a new area of application for SANS.

Mayes received SB (MIT) and PhD (Northwestern University) degrees in materials science and engineering. After two years as a visiting scientist at the IBM Almaden Research Center in San Jose, CA, she joined the faculty at MIT in 1993 and was later awarded the Class of '48 Career Development Chair (1995–1998). She has also received an NSF Young Investigator Award and a 3M Innovation Grant. She has filed four patent applications, and authored or co-authored 43 publications, including an article for the January 1997 issue of *MRS Bulletin*.

The Outstanding Young Investigator Award will be presented to Mayes on Monday, April 13, 6:00 p.m. at the 1998 MRS Spring Meeting in San Francisco. She will also give a presentation, "Tailoring Polymer Surfaces for Controlled Cell Behavior" on April 13 at 4:30 p.m. in Symposium CC, Pacific Room, San Francisco Marriott. MRS

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