**Polymer Interface and Surface Modification: From Designer Nanolaminates to Chemical Functionalization**

**Richard J. Spontak**, Ph.D., dr. h. c., FRSC, FIMMM, FPMSE

Departments of Chemical & Biomolecular Engineering  
and Materials Science & Engineering

North Carolina State University

Raleigh, NC 27695, USA

Email: spontak@ncsu.edu

**Abstract**

Since polymer surfaces serve to connect bulk polymers to their environment, they play a critical role in designing the function of soft materials. This presentation will focus on physico-chemical means by which to alter the interfacial and surface properties of polymeric materials at nanoscale dimensions. In the first case, nanolaminates containing diblock copolymers are used to introduce the concept of dewetting, which is subsequently employed as a direct measurement of interfacial compatibilization. Factors such as copolymer loading and molecular asymmetry are investigated, and evidence of both spinodal-like dewetting and competitive self-assembly is presented and discussed. By exploiting the difference between surface and interfacial energy, the thermal responsiveness of core-shell nanogel particles can provide a novel route by which to write information on polymer surfaces. Electrospun polymer microfibers are likewise made stimuli-responsive by grafting functional polymer chains onto the microfiber surface through the application of a gentle chemical synthesis approach. It is also demonstrated that chemical grafting-from, in conjunction with silicone elastomers, affords an attractive strategy for developing surfaces with remarkably tunable properties to control wettability and adhesion. Lastly, grafting-from is utilized to grow amine-containing polymers on high-flux polymer substrates to generate new "hybrid-integrated" (HI) carbon-capture membranes that effectively combine solution-diffusion and facilitated-transport mechanisms. This results in economical and robust membranes that concurrently exhibit ultrahigh CO2 permeability and CO2/N2 selectivity, and exceed the conventional Robeson permeability-selectivity trade-off by orders of magnitude.

**Biography**

Richard Spontak received his B.S. and Ph.D. degrees in Chemical Engineering from Penn State and UC Berkeley, respectively, and pursued post-doctoral studies at Cambridge University (UK) and the Institute for Energy Technology (Norway) before joining Procter & Gamble in 1990. In 1992, he transitioned to NC State University, where he is a Distinguished Professor. He has >300 peer-reviewed journal publications and >35 book chapters and invited works, and he has delivered >400 invited (including plenary and keynote) talks worldwide. He has received numerous honors including the American Chemical Society (ACS) Chemistry of Thermoplastic Elastomers Award (Rubber), the ACS Tess Award in Coatings (PMSE), the Society of Polymer Science, Japan, International Award, the Institute of Materials, Minerals and Mining (IOM3) Colwyn Medal and Medal for Excellence, the Society of Plastics Engineers International Award, and the NC State Holladay Medal. He is a fellow of the American Physical Society, the Royal Society of Chemistry, IOM3, and ACS-PMSE and a member of the Norwegian Academy of Technological Sciences, and he holds an honorary doctorate from NTNU in Norway.