**Functional Thermoplastic Elastomers to Meet Contemporary Needs**

**Richard J. Spontak**

*Departments of Chemical & Biomolecular Engineering and Materials Science & Engineering*

*North Carolina State University, Raleigh, NC 27695, USA*

*Email: spontak@ncsu.edu*

**Abstract**

Numerous designer polymers have been developed to address the growing number of needs in all technological areas. We pose the question, “Can one technology platform be made sufficiently versatile and robust so that it can significantly benefit many, but certainly not all, of society’s needs?” For this purpose, we elected to use thermoplastic elastomers, a class of self-networking macromolecules that are currently used in many commodity applications. In other words, these materials are abundantly available, and new ones are being synthesized from sustainable sources. Because of their innate ability to form networks and impart elasticity, we can exploit their mechanical properties while functionalizing them for specific applications. Here, several of these applications will be addressed, ranging from tunable compatibilizers and rubber-toughening agents in blends to stimuli-responsive standalone materials. Of particular interest in this vein are gas-separation membranes for removing basic (NH3) and acid (CO2) gases from gas mixtures [1], solar cells that can be designed to mimic leaves [2] or function as dye-sensitized devices [3], antimicrobial materials that can kill (to 99.9999+%) Gram-positive/negative bacteria, viruses (including SARS-CoV-2) and mold in ~5 min [4,5], and a new generation of quasi-solid Li-ion batteries that retain ~100% efficiency and >70% capacity after 1000 h (which equates to ~4 yrs).

**References**

1. Dai, Z., *et al*., *NPG Asia Mater.*, **11**, 53 (2019).
2. Al-Mohsin, H.A., *et al*., *Adv. Energy Mater*., **5**, 1401941 (2015).
3. Al-Mohsin, H.A., *et al*., *Sol. RRL*, **2**, 1700145 (2018).
4. Peddinti, B.S.T., *et al*., *Mater. Horiz*., **6**, 2056 (2019).
5. Peddinti, B.S.T., *et al*., *Adv. Sci.*, **8**, 2003503 (2021).

**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 his research has been featured on 31 journal covers and cited about 15,000 times. He has received numerous honors including the ACS Chemistry of Thermoplastic Elastomers Award (Rubber), the ACS Roy W. Tess Award for Coatings (PMSE), the SPSJ International Award, the IOM3 Colwyn Medal and the SPE International Award. He is a fellow of the American Physical Society, the Royal Society of Chemistry, IOM3, and the ACS PMSE Division, and he is a member of the Norwegian Academy of Technological Sciences.