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Title | Redox-active Macromolecular Radicals for a Metal-Free, Degradable Batteries

Abstract | Because of the projected shortages of elements used in Li-ion batteries and limited battery recycling, alternative electrode chemistries are gaining interest. Ideally, this future battery would contain materials that are easily sourced with little environmental impact, would be degradable or recyclable, and would bear similar or better energy storage characteristics in comparison to Li-ion batteries. This talk will examine one such promising battery chemistry, that of macromolecular radicals. These polymers generally contain redox-active nitroxide radical groups that reversibly exchange electrons at rates much higher than that of current metal oxide cathodes. This manifests as a higher power or a high charging rate. The current challenges for macromolecular radical batteries are to understand the redox mechanism, to increase the energy density in metal-free or aqueous conditions, and to consider a circular life cycle. Insight into the polymer's redox mechanism is provided using electrochemical quartz crystal microbalance with dissipation monitoring, in which mixed electron-ion-solvent transfer is quantified. This knowledge reveals why certain metal-free, aqueous electrolytes are well-suited to this polymer class. Last, an organic peptide battery that degrades on command into amino acids and byproducts provides a path forward toward recycling for a circular life cycle.

Bio | [Jodie L. Lutkenhaus](#) is holder of the Axalta Chair and Professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University. Lutkenhaus received her B.S. in Chemical Engineering in 2002 from The University of Texas at Austin and her Ph.D in Chemical Engineering in 2007 from Massachusetts Institute of Technology. Current research areas include polyelectrolytes, redox-active polymers, energy storage, and composites. She has received recognitions including World Economic Forum Young Scientist, Kavli Fellow, NSF CAREER, AFOSR Young Investigator, 3M Non-tenured Faculty Award. She is the past-Chair of the AIChE Materials Engineering & Sciences Division. Lutkenhaus is the Deputy Editor of ACS Applied Polymer Materials and a member of the U.S. National Academies Board of Chemical Sciences & Technology.

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