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Origins of enhanced capacity retention in copolymerized sulfur-based composite cathodes for Li-S batteries CHRISTOPHER SOLES, VLADIMIR OLESHKO, JENNY KIM, STEVEN HUDSON, NIST, KOOKEON CHAR, Seoul National University, JARED GRIEBEL, ADAM SIMMONDS, RICHARD GLASS, JEFF PYUN, University of Arizona — Poly(sulfur-random-(1,3-diisopropenylbenzene) (poly(S-r-DIB)) copolymers synthesized via inverse vulcanization form high molecular mass electrochemically active polymers capable of enhanced capacity (1005 mAh/g at 100 cycles) and lifetimes over 500 cycles as cathodes for Li-S batteries. In this presentation we characterize the morphology when the poly(S-r-DIB) copolymers are mixed conductive carbon to form functional Li-S cathodes. Scanning and transmission electron microscopy are used to demonstrate that the use elemental sulfur leads to heterogeneous aggregates of carbon nanoparticles and poor mixing with the sulfur, forming a loosely percolated network of electrically conductive pathways and extended micro- and mesoscale porosity. The poly(S-r-DIB) copolymers tend to mix more intimately with the carbon nanoparticles because of a stronger cohesion between the components. This increases the compositional homogeneity, increases the contact between the electrochemically active components and improves the physico-mechanical stability of the cathode which leads to increased capacity and enhanced cycle life in a full battery. We also introduce a new Li ion microscopy technique as a tool for characterizing battery materials.

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