Safety mechanism study of hyperbranched oligomers coated-cathodes lithium-ion batteries

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Self-terminated hyper-branched oligomers (STOBA) were coated on a $Li(Ni_{0.4}Co_{0.2}Mn_{0.4})O_2$ cathode and afterward melted to form a dense polymer film at high temperatures. The physical and structural changes of the polymer layer at different temperatures and charge conditions were investigated by nitrogen adsorption–desorption, X-ray photoelectron spectroscopy, four-point probe resistance measurement, scanning electron microscope, and solid-state ^{7}Li-NMR and ^{13}C-NMR spectroscopy in order to improve the understanding of the role of the STOBA layer in the enhancement of the safety mechanism of lithium ion batteries. The morphological transformation of the STOBA layer from the porous to nonporous was demonstrated at the temperature of a battery's thermal runaway state. The increase of resistance at high temperatures revealed that the STOBA coating is helpful for the prevention of internal short-circuit and thermal runaway. Furthermore, the ^{7}Li-NMR results acquired at a very high spinning speed (50 kHz) provide the subtle changes in the local environments of the Li^+ ions, and their interaction and mobility in the STOBA–cathode interface as functions of temperature and charge states. The combined characterization results not only prove the STOBA layer can contribute to the safety features of lithium ion batteries but also construct the fundamental mechanism of STOBA thermal reaction.