Metal Phenolic Network Nanolayer Coatings on Cathode Active Materials for Lithium Ion Battery Performance

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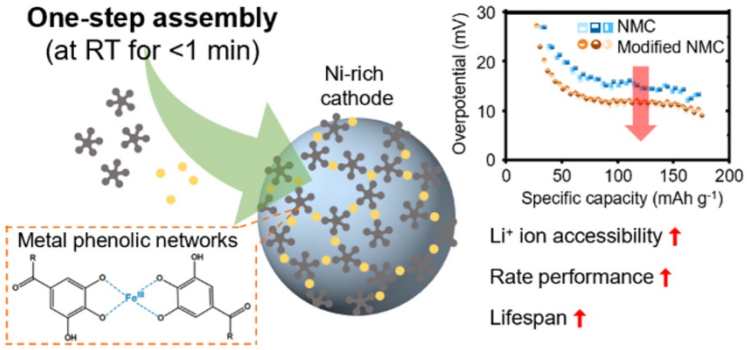
The talk reports on the coating of cathode active materials with a rapid (1 min) one-step assembly of a metal-phenolic network (MPN) for enhancement of electrochemical performance in lithium-ion batteries (LIBs). Here, a Fe(III)-tannic acid (TA) MPN coating was used on cathode active material ($LiNi_{0.6}Mn_{0.2}Co_{0.2}O_2$ (NMC)) which enabled progressive electrolyte infiltration and faster lithium-ion diffusion, while simultaneously protecting the cathode surface and suppressing uncontrolled solid electrolyte interphase (SEI) growth. In full-coin cell format, the modified cathode exhibited a 10% increase in capacity and a 54% increase in lifespan for constant current cycling. In addition to a 5% increase in capacity and a 25% increase in lifespan for constant current-constant voltage (CCCV) cycling. Moving further, various metal chelating ions (TA-Ni(II), TA-Zn(II), TA-Mn(III), TA-Ti(IV) and TA-Zr(IV) coatings were employed on a different active cathode material, namely, lithium iron phosphate (LFP). By changing the metal ion the ion transport properties (liquid and interfacial mass transport) were affected within the MPN [1]. Observed variations in interfacial transport consequently led to changes in the liquid transport kinetics with TA-Ti(IV) and TA-Zr(IV) coatings showing the greatest increase in rate capability at high mass loadings. This work paves the way for improving anode and cathode materials' performance via eco-friendly lithium-ion attraction strategies.

Keywords:
Metal phenolic networks, batteries, active material, interfacial electronic and ionic transport



Metal phenolic network (MPN) coatings on high nickel manganese cobalt oxide materials reduce overpotential and improve battery performance and lifespan.

References:

[1] Donghyuck Park, Subin Shin, Peter C. Sherrell, Bionayak Roy, Kimberely L. Callaghan, Frank Caruso, Amanda V Ellis. Improving energy storage and nickel manganese cobalt oxide cathode lifetime via a tannic acid/iron (iii) metal phenolic network coating, Advanced Functional Materials, 134(10): 104002 (2025).