

# Improving electrode materials' performance in Li-ion batteries

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Lithium-ion batteries (LIBs) have been widely applied for electric vehicles (EVs), portable electronic devices and energy storage systems possessing to their advantageous properties including high energy density, high power density, long cycle life and high energy efficiency. However, they still suffer from technological limits, performance limits as well as operational safety, hindering their widespread application.

Therefore, improving specific energy/power density and safety based on the current battery system is essential to satisfy the need for next-generation batteries in a near future. The spinel  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  (LTO) is a promising electrode anode material with the potential to supplement commercial graphite as an industry requirement in LIBs, however, its intrinsically low electrical conductivity and lithium-ion diffusivity need to be addressed. The spinel  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  (LNMO) has many advantages including high voltage, low cost, good rate capability, and environmentally friendly material. Major challenges for the LNMO cathode are the electrolyte decomposition under high operating voltage and transition metal dissolution.

Thus, different studies were investigated here in an attempt to determine possible strategies to supplement the popular graphite anode material and, on the other hand, another attempt to stabilise the LNMO/electrolyte interface at high operating voltage to able to overcome the main challenge of LNMO cathode.

Mesoporous LTO microspheres with carbon-coatings, which were produced via polymer phase separation, while co-assembly of LTO sol-gel precursors with amphiphilic BCPs created a very thin graphitic layer on the mesoporous surface during high-temperature calcination in argon. The carbon-coated layer significant enhance the electrical conductivity and the mesoporous structure increase the electrochemically active site and reduce the lithium diffusion length. The resulting material demonstrated an excellent electrochemical performance. An electrolyte additive can able to stabilise the electrode-electrolyte interface. The siloxane group in the (3-Aminopropyl)triethoxysilane (APTS) and (3- Glycidyloxypropyl)trimethoxysilane (GLYMO) additive can mitigate the hydrogen fluoride in the liquid electrolyte, and the amino group in the APTS additive can enhanced the forming passivation layer quality on the LNMO cathode surface. The final result was a facile approach that showed the addition of additive substantially improves the long- term cycling stability of the LNMO material at room temperature and elevated temperature

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