Regulated Surface Synergistic Layers of Layered Cathodes Through Low-Temperature Pyrolysis

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Introduction
A promising technique to improve LIBs is to construct a robust surface of carbon on Ni-rich cathodes to eliminate surface degradation and enhance battery performance [1,2].
- Ni-rich NMC (LiNi_{x}Mn_{1-x}O_{2}, where x ≥ 0.6) suffers from capacity fading and safety concerns. Low-temperature Pyrolysis can be done with carbon precursors cellulose and urea to synthesize a carbon layer on the surface of Ni-rich NMC cathodes.

Core Hypothesis
A carbon coating layer can transform the surface structure of Ni-rich NMC consisting of carbon coating and reconstruction layer. Its thickness can be fine-tuned by post-annealing protocols, i.e., employing low-temperature carbon precursors. The synergistic layer can not only suppress the surface degradation during cycling but also increase the surface stability against a moisture environment.

Results
- Carbon coated NMC111 experiences a decrease in specific capacity. Pyrolysis parameters must be changed to maintain the measured specific capacity of untreated NMC111.
- Pre-treatment and longer pyrolysis time of urea increases the capacity of NMC111 coated with urea.
- NMC111 coated with cellulose must be pre-treated for cells to operate.
- Capacity fading of NMC111 coated with cellulose is very high.
- The crystal structure of NMC111 is preserved during pyrolysis.

Next Steps
- X-Ray Photoelectric Spectroscopy (XPS)
- Cycling using BioLogic battery testing
- Optimize the pyrolysis parameters (time and temperature)

References