# Article information:

Synthesis and Characterization of the Lithium-Rich Core–Shell Cathodes with Low Irreversible Capacity and Mitigated Voltage Fade | Chemistry of Materials
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# Article summary:

1. Lithium-rich core-shell cathodes with low irreversible capacity and mitigated voltage fade were synthesized and characterized for use in rechargeable lithium ion batteries.

2. A core-shell structure with Ni-rich materials as the core and Mn-rich materials as the shell can balance the pros and cons of materials in a hybrid system, providing high energy density, good rate capability, and hindering electrolyte oxidation.

3. The structural and electrochemical properties of the core, shell, and CS materials were carefully measured and some excellent core-shell materials were developed.

# Article rating:

May be slightly imbalanced: The article presents the information in a generally reliable way, but there are minor points of consideration that could be explored further or claims that are not fully backed by appropriate evidence. Some perspectives may also be omitted, and you are encouraged to use the research topics section to explore the topic further.

# Article analysis:

The article discusses the development of lithium-rich core-shell cathodes for use in rechargeable lithium-ion batteries. The authors highlight the need for safer, longer-lasting batteries with higher energy density and lower cost, particularly for electric vehicles and stationary energy storage. They note that increasing the charging voltage of cells with NMC-based positive electrodes can increase energy density but can also lead to problems such as loss of active lithium inventory, gas formation, and increased viscosity of the electrolyte due to solvent loss.

The authors then discuss the use of layered lithium cobalt oxide (LCO) as a common positive electrode material but note that cobalt-free or low-cobalt alternatives are required due to the high cost of Co. They describe the Li-Ni-Mn oxide (NM) and Li-Ni-Mn-Co oxide (NMC) systems as promising alternatives, particularly lithium-rich NM/NMC materials with excess lithium in the transition metal layer. However, they note that these materials have issues such as prolonged "activation" during the first charge and serious voltage fade issues during cycling.

To address these issues, the authors propose a core-shell structure with Ni-rich materials as the core and Mn-rich materials as the shell. They describe their synthesis and characterization of these materials and report on their structural and electrochemical properties.

Overall, the article provides a thorough overview of current research on positive electrode materials for rechargeable lithium-ion batteries and presents a potential solution to some of their limitations. However, it is important to note that this is a single study conducted by a group of researchers affiliated with academic institutions and industry partners. As such, there may be biases or limitations in their approach or interpretation of results.

Additionally, while the authors acknowledge some potential drawbacks to their proposed solution (such as diffusion between core and shell phases), they do not thoroughly explore counterarguments or potential risks associated with this approach. It would be beneficial for future research to consider these factors and provide a more comprehensive analysis of the potential benefits and drawbacks of core-shell cathodes for lithium-ion batteries.

# Topics for further research:

* Lithium-ion battery safety concerns
* Cost-effective alternatives to cobalt-based cathodes
* Challenges with lithium-rich cathode materials
* Core-shell structures in battery electrodes
* Diffusion limitations in core-shell cathodes
* Voltage fade in rechargeable lithium-ion batteries

# Report location:

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