TECH OFFER

Co-free High-Nickel Cathode Materials for Lithium-Ion Batteries

KEY INFORMATION

TECHNOLOGY CATEGORY:
Energy - Battery & SuperCapacitor

TECHNOLOGY READINESS LEVEL (TRL): TRL4
COUNTRY: SOUTH KOREA
ID NUMBER: TO175459

OVERVIEW

The lithium-ion battery industry has long relied on cobalt-based cathode materials such as NCM (nickel–cobalt–manganese) and NCA (nickel–cobalt–aluminum) to achieve high energy density and stable performance. However, cobalt is expensive, environmentally unsustainable, and often associated with ethical issues in mining. As global demand for batteries continues to rise, there is an urgent need for cobalt-free alternatives that offer similar or better performance at lower cost.

This technology introduces a new class of cobalt-free, high-nickel layered cathode materials designed for next-generation lithium-ion batteries. With a nickel content above 90%, it achieves both high energy density and long cycle life through improved control of material composition and surface stability during synthesis.

The optimized process ensures high structural integrity, stable performance, and scalability for mass production—addressing key challenges in commercializing cobalt-free, nickel-rich cathodes. This innovation offers a sustainable, cost-effective, and high-performance solution that supports the battery industry's shift toward cleaner and more responsible manufacturing.

For more information, contact techscout@ipi-singapore.org

The technology owner is looking for R&D and licensing collaborations with battery material manufacturers, EV battery producers, and energy storage system companies seeking cobalt-free and high-performance cathode solutions.

TECHNOLOGY FEATURES & SPECIFICATIONS

- **Material composition:** Li(Ni, Mn, M)O_2 (M = Ti, Nb, Ta, W, Mo etc.)
- **Structure:** Layered Co-free oxide with superlattice ordering (c/a > 1.6459)
- **Grain morphology:** Uniform 40–60 nm rod-type particles with surface-enriched layers
- **Dopant control:** Temperature-feedback DB ensures reproducible sintering between 700–900 °C for each dopant type
- **Surface chemistry:** Mn oxidation and diffusion suppressed via controlled precursor oxidation ($Mn^{3+} \rightarrow Mn^{4+}$)
- **Electrochemical performance:**
    - Initial capacity > 200 mAh/g
    - 80 % capacity retention after 500 cycles
    - Enhanced interface stability (TOF-SIMS verified)

POTENTIAL APPLICATIONS

- **Electric vehicles (EVs):** High-energy, long-life batteries without cobalt dependency.
- **Grid-scale energy storage:** Stable, sustainable cathodes for long-cycle performance.
- **Portable electronics:** Lightweight, eco-friendly power sources with superior thermal stability.
- This Co-free high-nickel cathode platform can be adapted for both coin-cell and pouch-type battery systems, supporting scalability for mass production.

UNIQUE VALUE PROPOSITION

- **Cobalt-free & sustainable**: Eliminates cobalt without sacrificing stability or capacity.
- **Reproducible process:** Database-driven temperature calibration minimizes variation in large-scale synthesis.
- **Superior interface stability:** Mn diffusion control maintains gradient structure and prevents electrolyte decomposition.
- **High crystallinity & lifetime:** Optimized c/a ratio > 1.6459 ensures lattice stability even after long cycles.
- **Scalable manufacturing:** Simplified co-precipitation and solid-state lithiation processes support industrial adoption.
- Together, these advances enable high-energy, long-life, and eco-friendly batteries, ideal for both EV and stationary applications.