Revealing Progressive Degradation of Cobalt Oxide Nanoparticles During Thermochemical Redox Cycling

Scientific Achievement

Correlative environmental transmission electron microscopy (TEM) enabled operando study of thermochemical cyclability of nanoscale thermal energy storage materials under realistic operating conditions.

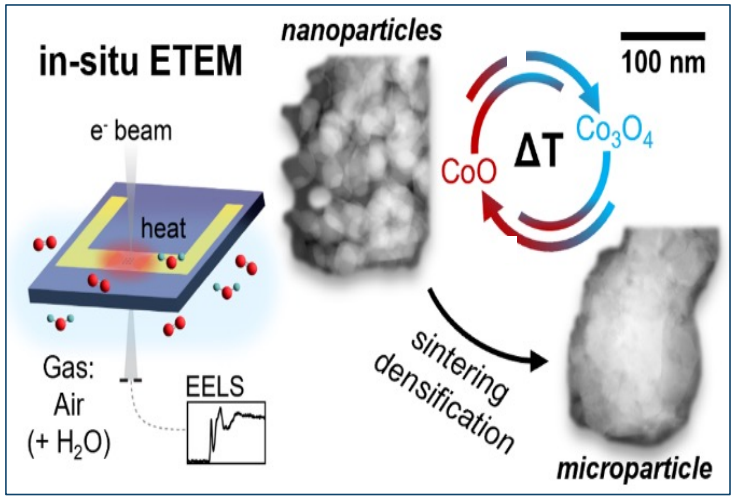

Figure: *Operando* STEM-EELS reveals that sintering-driven densification impairs thermochemical cyclability.

Significance and Impact

Sintering and densification are shown to be the main factors inhibiting long-term durability and performance of nanoscale thermochemical materials for energy storage.

Research Details

- Air with 38% relative humidity was piped into the TEM while thermally cycling cobalt oxide nanoparticles between 500-900 °C.
- Electron energy loss spectroscopy (EELS) monitored phase change behavior while imaging tracked microstructural evolution.
- High-speed in-situ EELS data allowed for high-resolution, targeted analysis of redox kinetics.

Work was performed, in part, at the Center for Integrated Nanotechnologies.

Van Winkle, M.; House, S.D.; Peng, Y; Chen-Wiegart, K.; Jungjohann, K.; Mangum, J.S.; Revealing Progressive Degradation of Cobalt Oxide Nanoparticles During Thermochemical Redox Cycling via Operando STEM-EELS. *Nano Letters*. 2025.