

## Unleashing disordered rocksalt oxides as cathodes for rechargeable magnesium batteries

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Schematics of the battery and present cathode material. The present material contains many metal elements as cations thanks to the effect of the high configurational entropy. Credit: Tohoku University

Researchers at Tohoku University have made a advancement in battery technology by developing a novel cathode material for rechargeable magnesium batteries (RMBs) that enables efficient charging and



discharging even at low temperatures. This innovative material, leveraging an enhanced rock-salt structure, promises to usher in a new era of energy storage solutions that are more affordable, safer, and higher in capacity.

Details of the findings were published in the *Journal of Materials Chemistry A*.

The study showcases a considerable improvement in magnesium (Mg) diffusion within a rock-salt structure, a critical advancement since the denseness of atoms in this configuration had previously impeded Mg migration. By introducing a strategic mixture of seven different metallic elements, the research team created a <u>crystal structure</u> abundant in stable cation vacancies, facilitating easier Mg insertion and extraction.

This represents the first utilization of rocksalt oxide as a cathode material for RMBs. The high-entropy strategy employed by the researchers allowed the cation defects to activate the rocksalt oxide cathode.

The development also addresses a key limitation of RMBs—the difficulty of Mg transport within <u>solid materials</u>. Until now, high temperatures were necessary to enhance Mg mobility in conventional cathode materials, such as those with a spinel structure. However, the material unveiled by Tohoku University researchers operates efficiently at just 90°C, demonstrating a significant reduction in the required operating temperature.

Tomoya Kawaguchi, a professor at Tohoku University's Institute for Materials Research (IMR), notes the broader implications of the study. "Lithium is scarce and unevenly distributed, whereas magnesium is abundantly available, offering a more sustainable and cost-effective alternative for <u>lithium-ion batteries</u>."



"Magnesium batteries, featuring the newly developed <u>cathode material</u>, are poised to play a pivotal role in various applications, including grid storage, <u>electric vehicles</u>, and portable electronic devices, contributing to the global shift towards renewable energy and reduced carbon footprints."

Kawaguchi collaborated with Tetsu Ichitsubo, also a professor at IMR, who says, "By harnessing the intrinsic benefits of <u>magnesium</u> and overcoming previous material limitations, this research paves the way for the next generation of batteries, promising significant impacts on technology, the environment, and society."

Ultimately, the breakthrough is a major step forward in the quest for efficient, eco-friendly energy storage solutions.

**More information:** Tomoya Kawaguchi et al, Securing cation vacancies to enable reversible Mg insertion/extraction in rocksalt oxides, *Journal of Materials Chemistry A* (2024). DOI: 10.1039/D3TA07942B

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