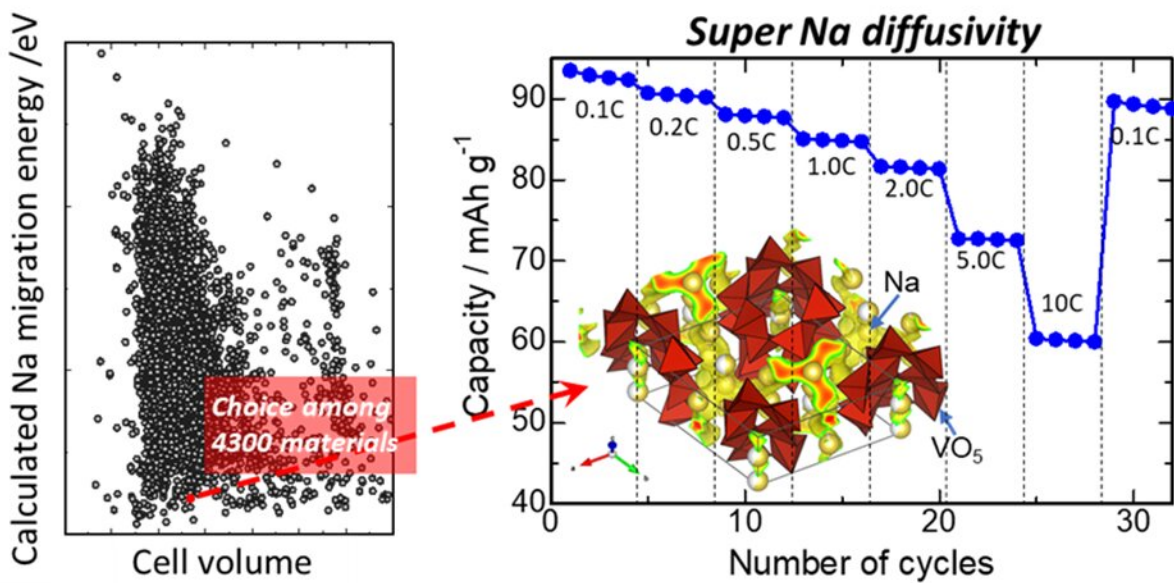


# Sodium is the new lithium: Researchers find a way to boost sodium-ion battery performance

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A high-throughput computation for Na migration energies is conducted for about 4,300 compounds in the inorganic crystal structure database, which the compound indeed exhibited excellent high-rate performance and cyclic durability; in detail, the compound exhibits stable 10C cycling, which

corresponds to the rate of only six minutes for full charge/discharge, and ca. 94 percent capacity retention after 50 charge/discharge cycles at room temperature. These results are comparable with or outperform representative cathode materials for sodium ion batteries. Credit: NITech

Researchers at the Nagoya Institute of Technology (NITech) in Japan have demonstrated that a specific material can act as an efficient battery component for sodium-ion batteries that will compete with lithium-ion batteries for several battery characteristics, especially speed of charge.

The finding was published in *Scientific Reports* in November of 2018 and the study was headed by Naoto Tanibata, Ph.D., an Assistant Professor at the Department of Advanced Ceramics at NITech.

The popular [lithium-ion batteries](#) have several benefits—they are rechargeable and have a wide application spectrum. They are used in devices such as laptops and cell phones as well as in hybrid and fully electric cars. The electric vehicle—being a vital technology for fighting pollution in rural areas as well as ushering in clean and sustainable transport—is an important player in the efforts to solve the energy and environmental crises. One downside to lithium is the fact that it is a limited resource. Not only is it expensive, but its annual output is (technically) limited (due to drying process). Given increased demand for [battery](#)-powered devices and particularly electric cars, the need to find an alternative to lithium—one that is both cheap as well as abundant—is becoming urgent.

Sodium-ion batteries are an attractive alternative to lithium-based ion batteries for several reasons. Sodium is not a limited resource—it is abundant in the earth's crust as well as in seawater. Also, sodium-based components have a possibility to yield much faster charging time given

the appropriate crystal structure design. However, sodium cannot be simply swapped with lithium used in the current battery materials, as it has a larger ion size and slightly different chemistry. Therefore, researchers are tasked with finding the best material for sodium ion battery among vast numbers of candidates by a trial-and-error approach.

Scientists at NITech have found a rational and efficient way around this issue. After extracting about 4300 compounds from a crystal structure database and following a high-throughput computation of these compounds, one of them yielded favorable results and was therefore a promising candidate as a sodium-ion battery component. The researchers identified that  $\text{Na}_2\text{V}_3\text{O}_7$  demonstrates desirable electrochemical performance as well as crystal and electronic structures. This compound promises fast charging performance, as it can be stably charged within 6 min. The researchers also demonstrated that the compound yields long battery life as well as a short charging time.

"Our aim was to tackle the biggest hurdle that large-scale batteries face in applications such as [electric cars](#) that heavily rely on long charge durations. We approached the issue via a search that would yield materials efficient enough to increase a battery's rate performance".

Despite the favorable characteristics and overall desired impact on [sodium-ion batteries](#), the researchers found that  $\text{Na}_2\text{V}_3\text{O}_7$  underwent deterioration in the final charging stages, which limits the practical storage capacity to half of the theoretical one. As such, in their future experiments, the researchers aim to focus on improving the performance of this material so that it can remain stable throughout the entire duration of the charging stages. "Our ultimate goal is to establish a method that will enable us to efficiently design battery [materials](#) via a combination of computational and experimental methods," Dr. Tanibata adds.

**More information:** Naoto Tanibata et al, Nanotube-structured Na<sub>2</sub>V<sub>3</sub>O<sub>7</sub> as a Cathode Material for Sodium-Ion Batteries with High-rate and Stable Cycle Performances, *Scientific Reports* (2018). [DOI: 10.1038/s41598-018-35608-9](https://doi.org/10.1038/s41598-018-35608-9)

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