New battery technology for electric vehicles

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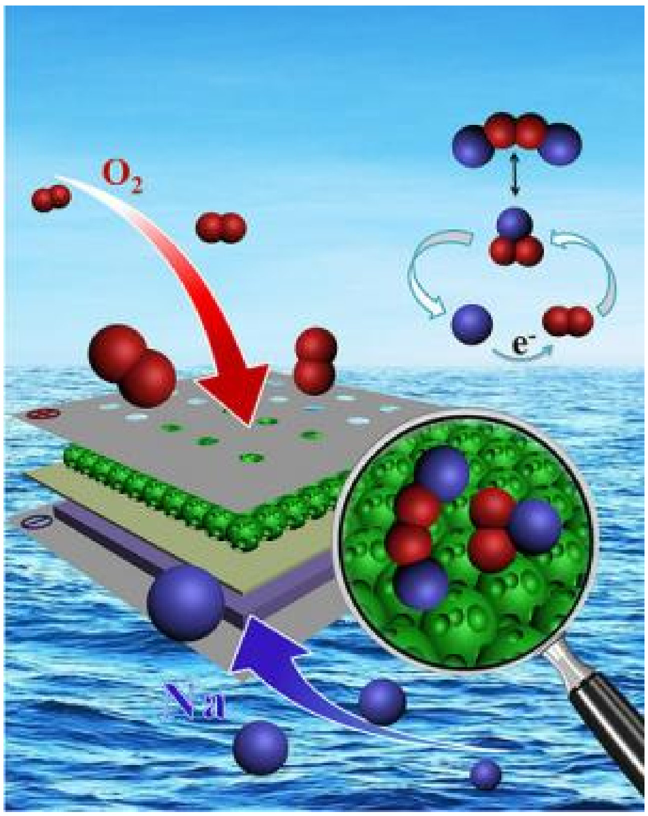

Fig.: Schematic diagram of sodium-air (Na-Air) batteries based on porous carbon electrodes.

Scientists at the Canadian Light Source are on the forefront of battery technology using cheaper materials with higher energy and better recharging rates that make them ideal for electric vehicles (EVs).

The switch from conventional internal combustion engines to EVs is well underway. However, limited mileage of current EVs due to the confined energy storage capability of available battery systems is a major reason why these vehicles are not more common on the road.

A group of researchers from the CLS and Western University have made significant strides in addressing the rechargeability and reaction kinetics of sodium-air batteries. They believe understanding sodium-air battery systems and the chemical composition and charging behaviour will contribute to manufacturing more road-worthy batteries for EVs.

"Metal-air cells use different chemistry from conventional lithium-ion batteries, making them more suited to compete with gasoline," said Dr. Xueliang (Andy) Sun, Canada Research Chair from Western's Department of Mechanical and Materials Engineering. "Development of new rechargeable battery systems with higher energy density will increase the EVs mileage and make them more practical for everyday use.

"On the other side, higher energy density battery systems will pave the road for renewable energy sources in order to decrease emissions and climate change consequences," said Sun.

During their experiments, researchers looked at different "discharge products" from the sodium-air batteries under various physicochemical conditions. Products such as sodium peroxide and sodium superoxide are produced. Understanding these discharge products is critically important to the charging cycle of the battery cell, since various oxides exhibit different charging potentials.

The experiments were conducted using the powerful X-rays of the CLS VLS-PGM beamline.

"We took advantage of the high brightness and high-energy resolution of the photoemission endstation, using a surface sensitive technique to identify the different states of the sodium oxides," said Dr. Xiaoyu Cui, CLS staff scientist. "We could also monitor the change in the chemical composition of the products by changing the kinetic parameters of the cell. The conclusive data from the CLS helped us confirm our hypothesis."

According to the researchers, only a few studies have ever addressed sodium-air battery systems, with limited understanding behind the chemistry of the cell. Their work was published in the journal *Energy and Environmental Science* and the authors believe the findings of the study contribute to better understanding the chemistry behind sodium-air cells which, in turn, will result in improved recharging rates and energy efficiencies.

"Although lots of research has been done to develop rechargeable, high energy metal-air battery cells during the past decade, there is still a long road ahead to achieve a practical high-energy battery system that can meet the demand for our current EVs," said Sun. "We are working to develop novel materials for different battery systems to increase the energy density and lifecycle.

"Metal-air batteries are less expensive compared with other battery systems such as lithium-ion. Specifically, sodium-air batteries are very cost effective since the materials can easily be supplied from natural resources – sodium and oxygen being among the most abundant elements on earth."

More information: Yadegari, Hossein, et al. "On rechargeability and reaction kinetics of sodium–air batteries." *Energy & Environmental Science* 7.11 (2014): 3747-3757. DOI: 10.1039/C4EE01654H

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