Atlas of Science
another view on science
http://atlasofscience.org

Progress of Na-ion battery performance in alloyed anode by ether-based solvent

Recently, secondary battery is most famous energy storage device. Especially, Li-ion batteries are used in many applications such as cellular phone, vehicles, mobile computers, and drowns. The Na-ion battery is a candidate for next generation secondary batteries because secondary battery with low price is provided due to the huge resource of Na.

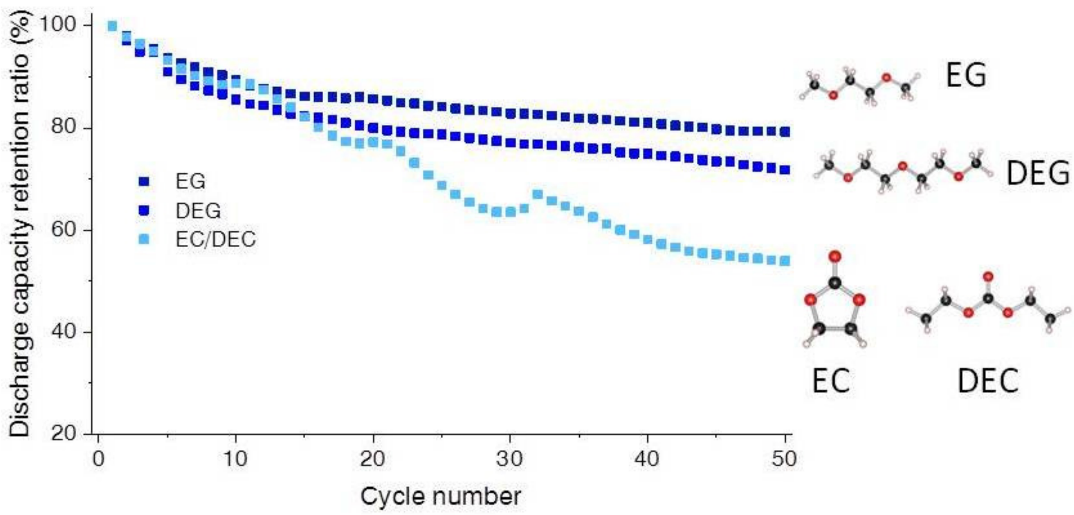

Fig. 1. Cycle performance of the amorphous GeOx anode with various solvent systems.

Among the potential anode materials for Na-ion batteries, Si, Ge, Sn, Sb, and Pb have been considered as high capacity anode materials. However, Sn, Sb, and Pb show poor cycle ability due to large volume changes during charge–discharge. This volume change is relatively smaller for Si and Ge. However, the theoretical capacity for Si has not been demonstrated. On the other hand, the theoretical capacity of Ge has been realized experimentally using nanowire and thin films. Authors have successfully synthesized amorphous GeO_x ($x < 1$) powder using solution method and demonstrated electrochemical performance as an anode material for Na-ion batteries. However, large irreversible capacity decay during the first charge–discharge and a poor cycling performance were observed owing to the decomposition of the electrolyte using carbonate solvent.

In this work, ether-based solvents could improve the electrochemical Na storage performance of amorphous GeO_x anodes. The Cycle performance and the first reversible capacity were much better with ether-based solvents (EG: Ethylene glycol dimethyl ether, DEG: Diethylene glycol dimethyl ether) than with carbonate solvents (EC/DEC: Ethylene carbonate / Diethylene carbonate) as shown in Figure 1. Although large volume changes of the electrode material during charge–discharge accelerate the electrolyte decomposition, ether-based solvents can significantly suppress the decomposition of the electrolyte. The layered of decomposition products on the electrode surface was thinner with ether-based solvents than with carbonate, from the result of depth profile in X-ray photoelectron spectroscopy. Ether-based solvents are stable at reduction state due to their high LUMO energy.

For Na-ion battery, requiring a more stable solvent at reduction state was suggested. This result will accelerate the development of Na-ion batteries.

Tetsuya Kajita
Frontier Research Institute for Interdisciplinary Sciences (FRIS), Tohoku University, Japan

Publication

Ether-based solvents significantly improved electrochemical performance for Na-ion batteries with amorphous GeOx anodes.
Kajita T, Itoh T
Phys Chem Chem Phys. 2017 Jan 4