Nanoporous Germanium Oxide Materials for Lithium Ion Battery Applications

조창신, 황종국, 이진우†
POSTECH
(jinwoo03@postech.ac.kr†)

Germanium oxides theoretically deliver the capacity high up to 2152 mAh/g. However, the development of stable GeO_2 anodes has been hampered by a huge volume change and irreversible conversion reaction of GeO_2. In this study, we present the development of nanoporous composite materials (m-GeO_2, m-GeO_2/C and m-Ge-GeO_2/C) with large pore size, synthesized by a block copolymer (BCP) directed co-assembly. Among the samples, m-Ge/GeO_2/C shows greatly improved reversible capacity (1631 mAh/g), high coulombic efficiency, and stable cycle-life compared with the other control samples. The excellent performance arises from the highly improved kinetics of conversion reaction due to the synergistic effects of the nanoporous structures and the composite structure. The detailed aspects and direct evidence for reversible conversion reaction are investigated by electrochemical evaluation, *ex-situ* X-ray diffraction, and *in-situ* X-ray absorption spectroscopy. We demonstrate that the tailoring nanostructures and composition of GeO_2 anodes can significantly improve their electrochemical performance. Therefore, this work paves the way for the development of high-capacity conversion/alloying anodes with high reversibility and cycle stability.