Research coating conductive material on SiO_x@rGO Composite Materials as Anode Material for Lithium-Ion Batteries

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With the advancement of technology, lithium-ion batteries have emerged as a future energy storage technology with the gradual development of electric vehicles. Silicon-based materials, due to their high theoretical capacity, energy density (~4200mAh/g), and natural abundance, are considered as candidates for negative electrode materials in lithium-ion batteries.

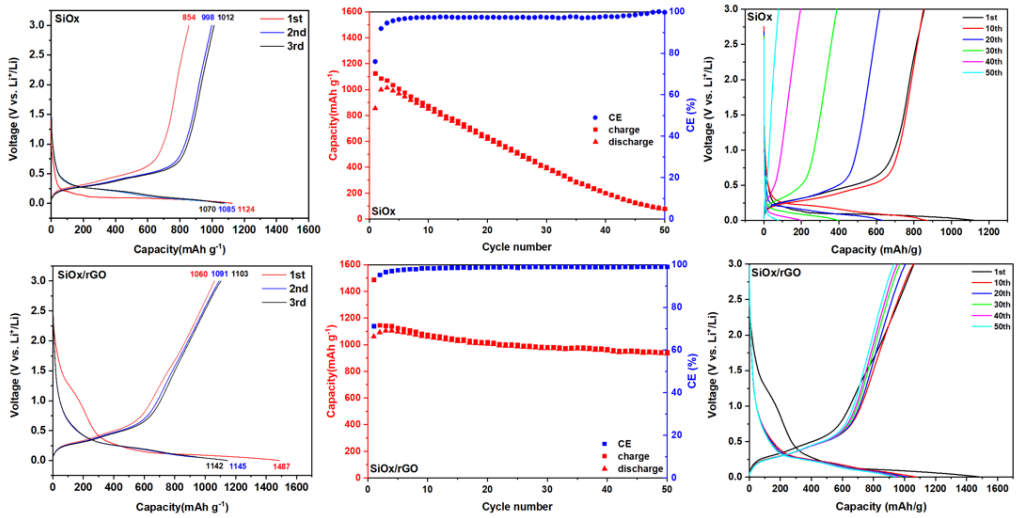
In this study, our research team successfully prepared reduced graphene oxide (rGO) using the Hummer method and incorporated commercial SiO_x micron-sized powder to synthesize SiO_x@rGO composite material as an anode for lithium-ion batteries. The initial charge capacity was measured at 1487 mAh/g, with a discharge capacity of 1060 mAh/g, yielding an initial coulombic efficiency of 71%. After 40 cycles, the capacity retention remained at 91%. However, there are currently no theoretical studies addressing the lithiation process and lithium ion insertion/extraction mechanisms in SiO_x materials.

Therefore, in our study, we not only explore the use of SiO_x@rGO composite material as an anode to improve the theoretical capacity and energy density of lithium-ion batteries but also aim to enhance the electrical conductivity and electrochemical performance of the battery. Conductive materials such as copper, gold, and platinum will be deposited on the prepared SiO_x@rGO anode material. These conductive coatings will provide additional electrons, creating a driving force for lithium ion diffusion into the anode material during discharge to achieve charge conservation. This process is expected to enhance the capacity and cycling stability of lithium-ion batteries. We will characterize the materials using X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS), and transmission electron microscopy (TEM). Furthermore, charge-discharge and cycling performance tests will be conducted on the lithium-ion batteries to investigate the effect of the conductive materials on their performance. Cyclic voltammetry will be employed to observe the electrochemical reactions during charge and discharge cycles.

This study conducts a theoretical analysis of SiO_x@rGO composite material as an anode for lithium-ion batteries by coating it with conductive materials, aiming to provide valuable reference data for both commercial and academic purposes.

Supplemental Information

- Galvanostatic lithiation/delithiation curves and cycling performance of SiO_x and SiO_x/rGO.



- Galvanostatic lithiation/delithiation curves of SiO_x and SiO_x/rGO electrodes coated with different conductive materials (e.g. Au, Pt) and different sputtering times (e.g. 2, 5 min).