Si-Graphene Oxide Heterostructures as Anode Material in Li-air Energy Storage Devices: Effect of the Si Loading

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In recent years, due to the rapid development of technology, the demand of efficient storage devices is increasing. Silicon has attracted increasing interest as a promising anode material for lithium-ion batteries due to its high theoretical capacity and abundance in nature. However, it exhibits large volume changes during the charging/discharging cycles causing irreversible capacity losses. To overcome these problems and increase the lifetime of the energy storage devices, research attention is focused on combining Si with 2D materials such as graphene oxide.

In this work, anodes have been fabricated by growing a Si nanoparticulate layer on the top of graphene oxide layer. In particular, the graphene oxide prepared by a modified Hummer's method was deposited through a spray procedure on a Cu substrate and then a Si-layer was grown on it with the same procedure. The Si nanoparticles were commercially available and two Si-loadings were studied in order to find the optimum loading for the best capacity and lifetime of the storage devices.

The potential application of Si-GO heterostructures were studied and evaluated as efficient anodes for Li-ion water-based batteries via cyclic voltammetry through Li^+ intercalation/de-intercalation consecutive scans. Furthermore, in order to investigate their stability over continuous Li^+ intercalation/de-intercalation cycles in aqueous electrolyte, the structural and morphological properties of the anodes were evaluated through X-ray photoelectron spectroscopy, Scanning electron microscopy, Energy dispersive spectroscopy and Raman spectroscopy.

Keywords: Graphene Oxide, Si nanoparticles, Aqueous Li-ion electrolyte, Anode materials, Li-ion batteries, Cyclic voltammetry