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Synthesis of Core/Shell Graphene/Semiconductor Nanostructures for Lithium Ion Battery Anodes

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Lithium-ion battery (LIB) is one of the most important rechargeable battery and portable energy storage for the electric digital devices. In particular, study about the higher energy capacity and longer cycle life is intensively studied because of applications in mobile electronics and electric vehicles. Generally, the LIB's capacity can be improved by replacing anode materials with high capacitance. The graphite, common anode materials, has a good cyclability but shows limitations of capacity (~374 mAh/g). On the contrary, silicon (Si) and germanium(Ge), which is same group elements, are promising candidate for high-performance LIB electrodes because it has a higher theoretical specific capacity. (Si:4200 mAh/g, Ge:1600 mAh/g) However, it is well known that Si volume change by 400% upon full lithiation (lithium insertion into Si), which result in a mechanical pulverization and poor capacity retention during cycling. Therefore, variety of nanostructure group IV elements, including nanoparticles, nanowires, and hollow nanospheres, can be promising solution about the critical issues associated with the large volume change. However, the fundamental research about correlation between the composition and structure for LIB anode is not studied yet. Herein, we successfully synthesized various structure of nanowire such as Si-Ge, Ge-Carbon and Si-graphene core-shell types and analyzed the properties of LIB. Nanowires (NWs) were grown on stainless steel substrates using Au catalyst via VLS (Vapor Liquid Solid) mechanism. And, core-shell NWs were grown by VS (Vapor-Solid) process on the surface of NWs. In order to characterize it, we used FE-SEM, HR-TEM, and Raman spectroscopy. We measured battery property of various nanostructures for checking the capacity and cyclability by cell-tester.

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