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Synthesis and characterization of Graphene nanosheets as electrode for Li ion storage applications

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Recently, Li ion batteries are being considered as energy storage devices for various ranges of applications, including portable electronics and PHEV, EV applications due to their high volumetric and gravimetric energy densities compared to that of other secondary batteries like Ni-MH. Lithium rechargeable batteries require increasingly high power and energy density due to the development of high performance portable electric devices, electric vehicles, and battery energy storage systems. To overcome these problems, innovative material is needed both of cathode and anode. Graphite is widely used as anode material in lithium ion batteries owing to its high columbic efficiency and acceptable specific capacity by forming intercalation compounds (LiC6) [1]. Graphite has a Li storage capacity of ~370 mAh g_{-1} due to limited Li-ion storage sites within sp_2 carbon structure. In order to enhance their energy and power density, another anode material is needed. Many researchers study about anode materials to substitute graphite. One of the candidates is Si and Sn based materials Silicon and its alloys have been studied as high capacity alternative anode materials to graphite but these material has severe problems like volume expansion during cycle advanced.

Graphene was considered a potential alternative material as anode to graphite in LIB. Graphene has been receiving dramatic attentions these days, because it has a single 2D atomic layer (sp^2 carbon configuration and π-π complexation) densely packed in a honeycomb lattice. Graphene has high reversible capacities ranging from 500~120 mAh g_{-1} for Li storage capacities have been reported[2-3]. Graphene can be manufactured by the exfoliation of graphite powder or epitaxial growth on silicon carbide. The graphite exfoliation can be achieved by the strong oxidation of the graphite layers which can yield graphite oxide. The graphite oxide (GO) is hydrophilic; and has continuous aromatic structure with epoxides, alcholes, keptone carbonyls and carboxylic groups. Those functional groups are enabling to exfoliate the graphite layers and create the inter-layer spacing (*d*-spacing). Up to days, many studies are focusing on the properties of the graphite oxide and graphene for the applications, especially for the Li-ion battery. "Hummers' method" is generally considered as a typical method to produce a graphite oxide and many previous studies used this method or modified Hummers' method.

In this study, we focus the strategic synthesis and characterization of graphite oxide and reduced graphene nanosheet. The "improved" synthesis method using phosphoric acid as a second acid in order to enlarge the graphene layer spacing (*d*-spacing) has been announced. Fig 1. Shows the TEM images of graphene nanosheets manufactured different condition, respectively. We will report in detail about the latest results achieved on graphene nanosheet as anode material for lithium-ion batteries.

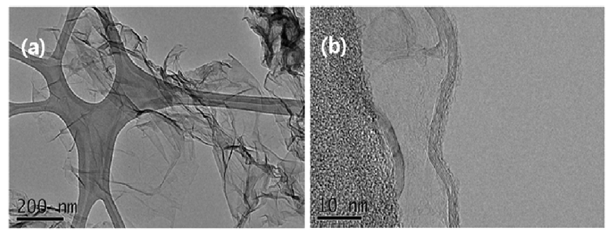

Fig 1. TEM images of (a) graphene nanosheet and energy induced graphene nanosheet

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