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Understanding the effect of particle (powder) size of commercially available graphite powder on the synthesis and characterization of graphene oxide

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Graphene oxide (GO) and graphene are of very high importance in the present research and development of electrochemical applications. The most common synthesis method of graphene oxide and graphene is based on oxidation of graphite to graphite oxide and subsequent reduction of graphene oxide to graphene. Therefore, it is of paramount importance to investigate to which extent the parent materials and the reaction conditions influence the synthesis process and the properties of the resulting products. Parent materials and the reaction conditions influence the synthesis process and the properties of the resulting products. In the present study we have tried to understand the effect of the particle size of graphite powder on the properties of graphene oxide. Two methods have been employed in reduction/dispersion of particle size, viz. ultra-sonication, and ball-milling. It has been observed that the size reduction method has a considerable influence on the graphite particle size. Ball-milled graphite has a well reduced particle size compared to that of ultra-sonicated graphite. The particle size (d₅₀) of commercially available graphite powder is about 111 μm, whereas graphite powder ball-milled for at least 3 h is about 37 μm and the powder with ultra-sonication at least for 30 mins is about 53 μm. Therefore, based on the reduced particle size of the two methods, the ball-milling was chosen for the synthesis of graphene oxide. The properties were analyzed using Laser-diffraction technique, UV-Vis spectroscopy, SEM and FTIR methods. The absorption near UV range (~ 233 nm) and the oxygen functionalities (OH stretching, C-O etc) have increased in GO synthesized using ball-milled graphite powder compared to GO synthesized from commercial graphite. The SEM images also showed that the split graphene oxide layers are more conspicuous in GO made from ball-milled graphite than that made from commercial graphite. Our findings will have a profound influence on practical synthesis of graphite oxide and graphene for applications in electrochemical devices in the future.

Keywords: Particle size, graphene oxide (GO), graphene, ball-milling, UV-Vis, FTIR,

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