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Facile electrochemical synthesis of triangle-shaped graphene nanoflakes and graphene quantum dots via surfactant-assisted and defect-induced mechanism

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Abstract

A facile and non-hazardous route for synthesis of triangle-shaped graphene nanoflakes and graphene quantum dots (GQDs) suspension via electrochemical exfoliation has been reported. In this work, a simple electrochemical technique was employed using pristine and heated graphite electrodes under the influence of anionic surfactant, sodium dodecylbenzene sulfonate (SDBS). The synthesized graphene nanoflakes and GQDs suspension were characterized using UV-visible

spectroscopy, transmission electron microscope (TEM) and Raman Spectroscopy. The UV absorption spectra showed a bathochromic shift from the typical π → π Transition peak which due to the introduction of oxygen groups and/or functionalization of SDBS into the graphitic layers. Morphological analyses using TEM revealed the usage of heated graphite electrodes (600 °C at 5 min) produced a triangleshaped graphene nanoflakes with an average size of _34 nm while the average size of the graphene nanoflakes obtained using the pristine graphite is _47 nm. A possible mechanism for the exfoliation of such morphology has been proposed. The graphene nanoflakes which have size less than 10 nm from both samples can be attributed to the presence of the GQDs. Raman analysis revealed ID/IG ratio of 0.223 and 0.203 for graphene nanoflakes electrochemically exfoliated from pristine and heated graphite respectively, which signifies a better quality and crystallinity and has low defects within the conjugated graphene backbone. The utilization of this electrochemical approach might expectantly pave the way towards the production of graphene nanoflakes with controlled morphology and low structural defects, which can be an efficient top-down process yet feasible for mass production.

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Electrochemical ; Exfoliation; Graphene nanoflakes ; Graphene quantum dots; Triangle-shaped

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