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rGO Wrapped Flowerlike Bi_2Se_3 Nanocomposite : Synthesis, Experimental and Simulation Based Investigation on Cold Cathode Applications

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Synthesis of Bi_2Se_3 Nanoflowers (NFs):

Bi_2Se_3 NFs ware synthesized[1-3] using $Bi(NO_3)_3.5H_2O$ (99.99%) and Na_2SeSO_3 (99.99%) as sources of Bi^{3+} and Se^{2-} respectively. In a typical synthesis procedure, a chemical bath was prepared of 4 ml 0.1M $Bi(NO_3)_3.5H_2O$ and 80ml 0.1M nitrilo-tri-acetic acid (NTA) to form the bismuth chelate. Under constant stirring, 4 ml 0.5M ascorbic acid (AA) was added into the above mixture as reducing reagent. The pH of the solution was adjusted in between 8.50 - 9.00 by dropwise addition of ammonia solution until a transparent solution was formed. 6 ml of freshly prepared 0.1M Na_2SeSO_3 solution was dropwise added into the previous mixture solution. The synthesis was carried out in a hot oil bath at 75 ^oC for 2.5 h with constant stirring. After the above mentioned period, the solution was allowed to cool naturally up to room temperature. The black precipitate was collected from the bath and filtered several times with DI water and ethanol, and dried naturally at room temperature.

Synthesis of Graphene Oxide (GO) by modified Hummer's method:

Graphene oxide (GO) was synthesized by modified Hummer's method.[4,5] Commercially available graphite powder (Sigma-Aldrich, 99.99%), sodium nitrate (99.99%) & potassium permanganate (99.99%) were used as starting materials. Pure graphite & sodium nitrate were properly mixed with conc. sulphuric acid (98 %) keeping temperature below 5^0C and stirred for up to 10-15 minutes. Potassium permanganate ($KMnO_4$) was slowly added afterward to the pre-treated solution under vigorous stirring for 80 min in ice bath keeping temperature below 0^0 C. The mixture was stirred for additional 1h to mix the all precursors properly. The solution was then taken out from ice-bath and heated at 50^0 C-60^0 C for 80 min without stirring, followed by dilution with DI water.

The mixture was again stirred for 1h and further diluted with 200 ml of DI water. After that, H_2O_2 (30%) was added. Upon addition, the mixture turned bright yellow from dark brown. The mixture was then filtered and washed several times with DI water for removal of metal ions until the pH of the solution became 5-6. Then final GO is dispersed in DI water with 1:1 loading (1 mg/ml). The solution was centrifuged at 5000-6000 r.p.m for proper exfoliation of GO & supernatant was collected.

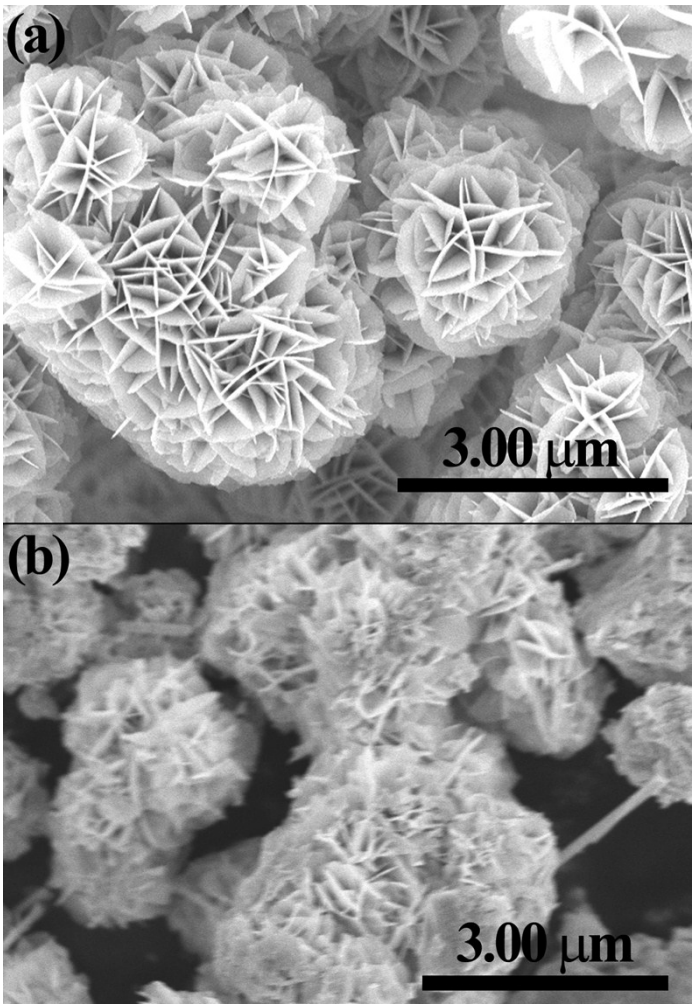

Figure S1: Low magnification FESEM image of (a) pure and (b) rGO wrapped Bi_2Se_3 (BG20)

References

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