Electronic Supplementary Information (ESI)

Improved photocatalytic activity of RGO/MoS₂ nanosheets decorated on TiO₂ nanoparticles

Dipak Bapurao Nimbalkar, Hsin-Hsi Lo, P.V.R.K. Ramacharyulu and Shyue-Chu Ke*

* To whom correspondence should be addressed:

Department of Physics, National Dong Hwa University, Hualien 974-01, Taiwan

E-mail: ke@mail.ndhu.edu.tw

1. Synthesis of graphene Oxide

Graphene Oxide was prepared by modified Hummer's method²². Firstly, 500 mg of graphite powder and 23 ml of H_2SO_4 were stirred constantly in an ice bath condition for 30 min. To the above solution, 300 mg of NaNO₃ was added, and stirred for 2 h. 1500 mg of KMnO₄ was added slowly portion wise of the above mixture, care should be taken that the temperature should not exceed above 20^oC. Then the solution was stirred at room temperature for 30 min and at 35^oC for 2 h. with constant stirring rate. The obtained suspension was diluted by adding 25 ml of double distilled water and heated to 95^oC in an oil bath for 15 min. with constant stirring. The suspension was become gray in color and thicker. The oil bath was removed and stirred another 1.5 h. at room temperature by adding 100 ml of double distilled water slowly for 30 min. Finally, 6 ml of 30% of H_2O_2 was added and stirred for several minutes and kept for decaying for 12 h. Resultant product

was washed out with HCl, water and ethanol repeatedly until the pH reach to 6. The sample was washed, filtered, and centrifuged for pH adjustment. The obtained yellow-brownish suspension was vacuum dried at 60^oC for 6 h.

2. Synthesis of reduced graphene oxide (RGO)

Above graphene oxide was used as a starting material to prepare reduced graphene oxide. In a typical procedure, 75 mg graphene oxide was dispersed in 75 ml water and sonicated for 1 h. A clear, brownish dispersion of graphene oxide was formed. To the above dispersion of graphene oxide, 600mg of sodium borohydride in 15 ml of DD water was added. The mixture was then kept at 80°C for 1 h under constant stirring. During the reduction process the dispersion was turned to black from dark brown color accompanied by out-gassing. Observed aggregation was centrifuged and rinsed with water several times, the partially reduced graphene oxide was redispersed in 75 ml water followed by mild sonication for post reduction treatment. 2 ml hydrazine dissolved in 5 ml DD water was added to the dispersion, the reaction mixture was kept at 100 °C for 24 h under constant stirring. The obtained sample was washed with water thoroughly and vacuum dried.



Figure 1 FE-SEM image of separated few layers of MoS₂ nanosheets.



Figure 2 (a) TEM and (b) HR-TEM images of TiO₂-RGO/MoS₂ heterogeneous hybrid composite.



Figure 3 XRD of as-prepared (a) RGO and (b) TiO₂ heterogeneous hybrid composite.



Figure 4 XPS spectra of as- prepared sample of MoS₂ (a) Mo 3d and (b) S 2p.



Figure 5 Methylene Blue (MB) photocatalytic degradation of TiO₂-RGO/MoS₂ hybrid composite under Sunlight illumination.