SYNTHESIS, FUNCTIONALIZATION AND ENVIORNMETAL APPLICATIONS OF THERMALLY REDUCED GRAPHENE

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In this presentation, we review our research efforts on the production, functionalization and applications of thermally reduced graphene (TRG) in oil spill cleanup and wastewater treatment. TRG produced by thermal exfoliation of graphite oxide has been characterized by XPS, FTIR, Raman, BET, TGA, SEM, and TEM. Depending on the oxidation and exfoliation conditions, TRG with with C/O ratio ranging between 6/1 to 13/1 are produced.

A method for the uncatalyzed functionalization of TRG with aminopropyl triethoxysilane (APTS) is also discussed. Functionalized TRG (f-TRG) with a very high grafting yield of APTS, up to 8 atomic% Si. We found that different APTS attachments to the graphene surface exist depending on whether the reaction takes palce in presence or absence of a solvent (toluene). The structural difference between the TRG, f-TRG made using pure APTS, and f-TRG made by APTS solution are confirmed by XPS, EFTEM and EELS spectroscopy. Thermal analysis and temperature-dependent electrical conductivity measurements are also used to describe the structural differences.

We proved that TRG is a very efficient adsorbent for oil-spill clean up and dye removal from wastewater. TRG sorption capacity for crude oil depends on TRG bulk density and C/O ratio as well as the oil density and viscosity. Maximum sorption capacity of 131 g-crude oil/g-TRG has been reached, which is higher than any reported capacity. Moreover, the removed oil can be recovered via vacuum filtration and TRG can be reused. A collective capacity of 300 g-crud oil/g-TRG is obtained in 6 cycles. When used to remove environmentally hazardous dyes such as methyl orange (MO) methylene blue (MB) and malachite green (MG) from the wastewater, TRG exhibited a maximum sorption capacity of 100, 200 and 400 mg-dye/g-TRG for MO, MB and MG dyes with a maximum removal efficiency of ~100%.