

Sonochemical synthesis of reduced graphene oxide uniformly decorated with hierarchical ZnS nanospheres and its enhanced photocatalytic activities

ABSTRACT

Reduced graphene oxide (rGO) decorated with zinc sulphide nanospheres (ZnSNSs) was synthesized through the simple ultrasonic irradiation of an aqueous solution containing zinc acetate dihydrate ($\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$), thioacetamide ($\text{C}_2\text{H}_5\text{NS}$), and graphene oxide (GO). The results of X-ray diffraction, Fourier-transform infrared transmission spectroscopy, X-ray photoelectron spectroscopy and Raman spectroscopy confirmed the simultaneous formation of cubic-phase ZnSNSs and the reduction of GO through the ultrasonic irradiation process. Field emission scanning electron microscope images showed that the size and number density of the nanoparticles could be tuned by adjusting the precursor amounts. Transmission electron microscopy images showed that the spherical ZnS nanoparticles were comprised of small nanoparticles with an average size of ~ 5 nm aggregated together. The result of photoluminescence spectroscopy and Brunauer–Emmett–Teller (BET) measurement demonstrated that the incorporation of reduced graphene oxide (rGO) sheets with ZnSNSs suppressed the electron–hole recombination and increased the surface area of the composite. Hence, a significant enhancement in the photocatalytic degradation of methylene blue (MB) was observed with the ZnSNSs–rGO nanocomposite, compared to the bare ZnS particles.

Keyword: Sonochemical; Synthesis; Graphene oxide; ZnS nanospheres; Photocatalytic activities