One-pot sonochemical synthesis of reduced graphene oxide uniformly decorated with ultrafine silver nanoparticles

Huang Nay-Ming & Amir Moradi Golsheikh

Low Dimensional Materials Research Centre, Physics Department, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia..edu.y

Abstract

Reduced graphene oxide (rGO) uniformly decorated with silver nanoparticles (AgNPs) is synthesized through a simple ultrasonic irradiation of the aqueous solution containing silver ammonia complex ($Ag(NH_3)_2OH$) 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 AgNPs and the reduction of GO through the ultrasonication process. The size of the nanoparticles could be tuned by adjusting the volume ratio of the precursors and the ultrasonic irradiation time. Transmission electron microscope images show a uniform distribution of ultrafine spherical AgNPs with a narrow size distribution on the rGO sheets, which could only be achieved using silver ammonia complex instead of silver nitrate as the precursor. The average particle size of silver with the narrowest size distribution is 4.57 nm. The particle size and its distribution are directly proportional to the ultrasonic irradiation time. The rGO/Ag nanocomposites is highly stable in aqueous solution and render it to many potential applications.

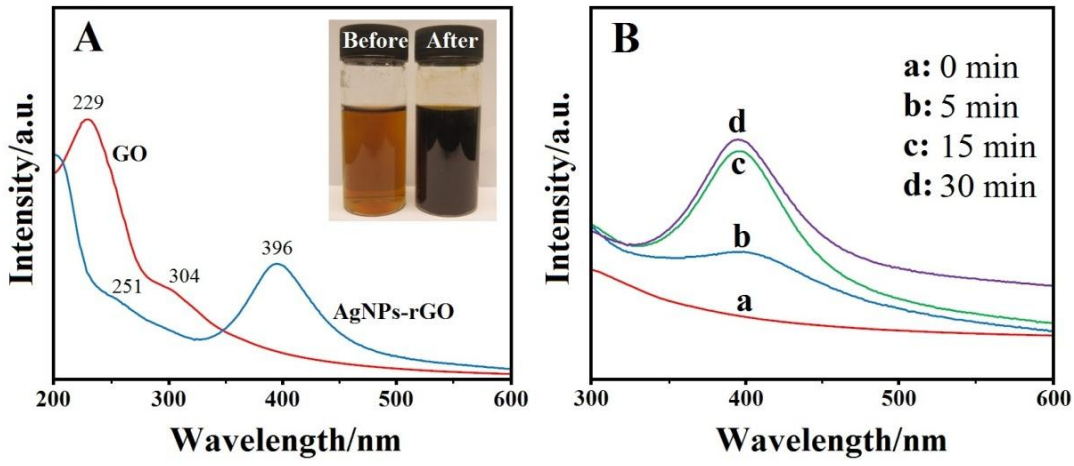

Figure 2. (A) UV-Vis absorption spectra of GO and AgNPs-rGO (the inset shows the photograph of the solution of GO and $Ag(NH_3)_2OH$ before and after ultrasonic irradiation), (B) time evolution of UV-Vis absorption spectra of AgNPs-rGO.

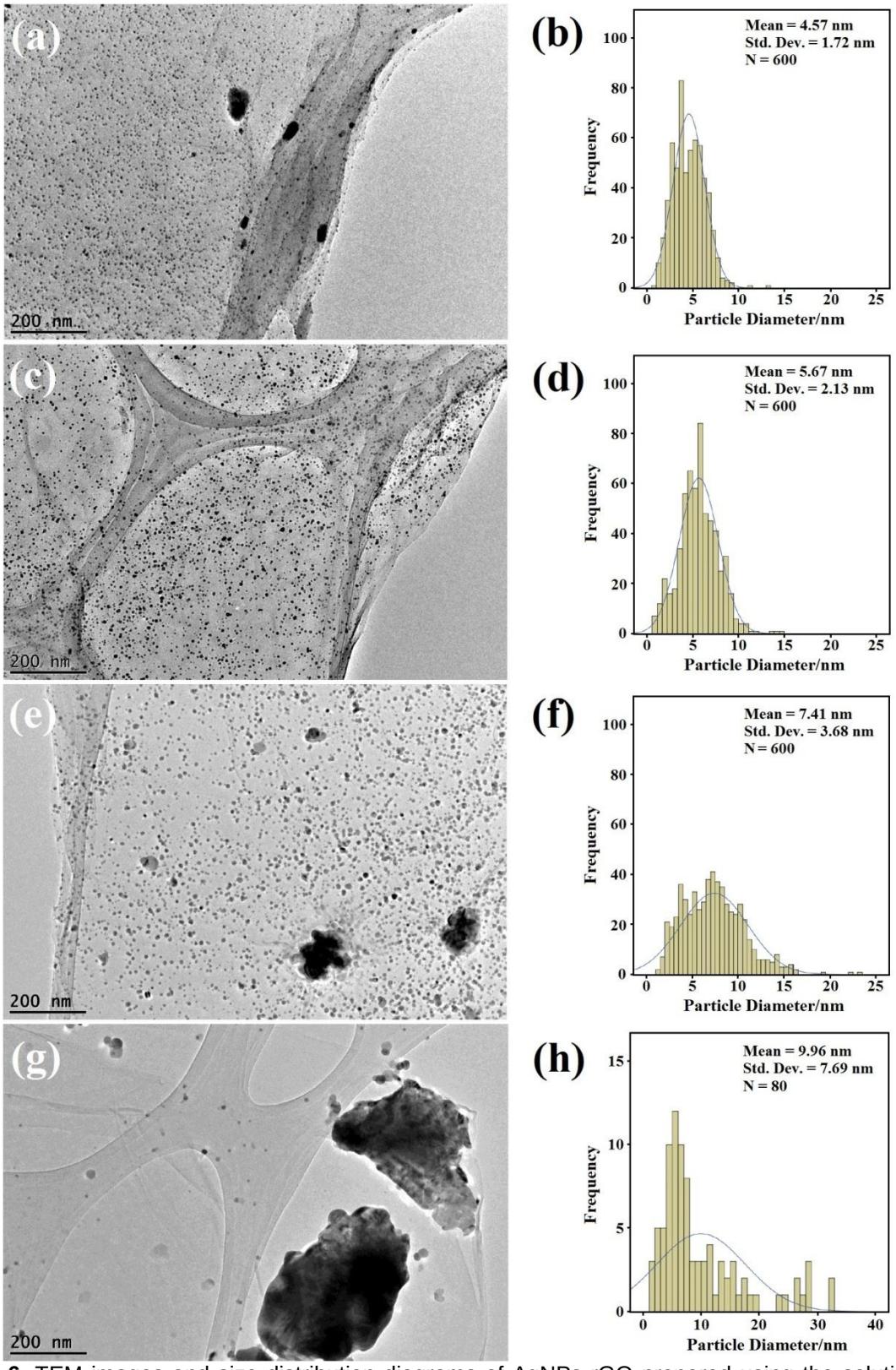

Figure 6. TEM images and size distribution diagrams of AgNPs-rGO prepared using the solution with GO (1.0 mg/mL) to $Ag(NH_3)_2OH$ (0.04 M) volume ratios of 8 (a and b), 4 (c and d), 2 (e and f) as well as the solution with GO (1.0 mg/mL) to $AgNO_3$ (0.04 M) volume ratio of 4 (g and h) with the same ultrasonic irradiation time of 5 min.