

Fabrication of Carbon Nanoparticles and Graphene Using Pulsed Laser Ablation

Authors : Davoud Dorrnian, Hajar Sadeghi, Elmira Solati

Abstract : Carbon nanostructures in various forms were synthesized using pulsed laser ablation of a graphite target in different liquid environment. The beam of a Q-switched Nd:YAG laser of 1064-nm wavelength at 7-ns pulse width is employed to irradiate the solid target in water, acetone, alcohol, and cetyltrimethylammonium bromide (CTAB). Then the effect of the liquid environment on the characteristic of carbon nanostructures produced by laser ablation was investigated. The optical properties of the carbon nanostructures were examined at room temperature by UV-Vis-NIR spectrophotometer. The crystalline structure of the carbon nanostructures was analyzed by X-ray diffraction (XRD). The morphology of samples was investigated by field emission scanning electron microscope (FE-SEM). Transmission electron microscope (TEM) was employed to investigate the form of carbon nanostructures. Raman spectroscopy was used to determine the quality of carbon nanostructures. Results show that different carbon nanostructures such as nanoparticles and few-layer graphene were formed in various liquid environments. The UV-Vis-NIR absorption spectra of samples reveal that the intensity of absorption peak of nanoparticles in alcohol is higher than the other liquid environments due to the larger number of nanoparticles in this environment. The red shift of the absorption peak of the sample in acetone confirms that produced carbon nanoparticles in this liquid are averagely larger than the other medium. The difference in the intensity and shape of the absorption peak indicated the effect of the liquid environment in producing the nanoparticles. The XRD pattern of the sample in water indicates an amorphous structure due to existence the graphene sheets. X-ray diffraction pattern shows that the degree of crystallinity of sample produced in CTAB is higher than the other liquid environments. Transmission electron microscopy images reveal that the generated carbon materials in water are graphene sheet and in the other liquid environments are graphene sheet and spherical nanostructures. According to the TEM images, we have the larger amount of carbon nanoparticles in the alcohol environment. FE-SEM micrographs indicate that in this liquids sheet like structures are formed however in acetone, produced sheets are adhered and these layers overlap with each other. According to the FE-SEM micrographs, the surface morphology of the sample in CTAB was coarser than that without surfactant. From Raman spectra, it can be concluded the distinct shape, width, and position of the graphene peaks and corresponding graphite source.

Keywords : carbon nanostructures, graphene, pulsed laser ablation, graphite

Conference Title : ICNN 2016 : International Conference on Nanoscience and Nanotechnology

Conference Location : Istanbul, Türkiye

Conference Dates : February 15-16, 2016