Materials Chemistry and Physics

Formation of monodispersed carbon nanospheres by pulsed laser irradiation of HOPG

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Abstract

Monodispersed carbon-based nanostructures in the diameter range of 40–50 nm have been produced by pulsed laser irradiation. A pulsed ultraviolet laser light (308 nm) was used to irradiate Highly Oriented Pyrolytic Graphite surfaces with power densities of the order 108 W cm−2. Scanning Electron Microscope images have exhibited a homogenous size distribution of amorphous carbon nanospheres as confirmed by the ID/IG ratio of the Raman spectra. It is shown that the presence of hydrogen acts as a nucleating agent for the carbon nanospheres observed at the outer region of a shockwave induced by the laser pulses at the point of impact. The effect of the energy density, the number of pulses applied to the sample, and the hydrogen flow rate are investigated to elucidate the phase transition from surface graphite-to-carbon nanospheres. Using analytical approaches, we establish the thermodynamic variables (temperature and pressure) corresponding to the laser pulses that drive the structural transformation in hydrogen.