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Carbon nanoparticles synthesized by the laser ablation in liquid

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Pulsed Laser Ablation in Liquid (PLAL) is widely recognized method of synthesizing contamination free nanostructures especially nanoparticles [1] among them Fluorescent Carbon Nanoparticles (FCNPs) [2], carbon polyynes [3] etc. Most of the attention is given to fluoresent nanoparticles which are widely used for purposes of fluorescent imaging, mainly of cells and tissues [4].In this paper the synthesis of the carbon nanoparticles (CNPs) was performed by laser ablation of polycrystalline carbon target immersed in various liquids as deionized water, acetone and polyethylene glycol 200 (PEG200). Graphite target irradiation was performed using an Nd:YAG laser (Quantel, 981 E). The laser operated at a wavelength of 1064, 532 and 355 nm with a 10 ns pulse duration and repetition rate of 10 Hz. The laser fluence varied from 3 to 20 $J \cdot cm^{-2}$. The thickness of liquid layer over the target was about 4 mm.

The analysis of synthesized nanoparticles was made using transmission electron microscopy (TEM), high resolution TEM (HRTEM), Dynamic Light Scattering as well as the absorption and fluorescence spectroscopy. Nanoparticles of diverse sizes ranging from 2 to 100 nm were formed depending on the experimental conditions.

The fluorescent carbon nanoparticles were obtained in acetone and PEG. The nanoparticles synthesized in water did not exhibit the fluorescence properties.

Figure 1 shows the optical properties of carbon nanopartices synthesized in PEG200 using 355 nm laser radiation at a fluence of 15 $J \cdot cm^{-2}$. The irradiation time was 15 min. In this case sizes of the most abundant CNPs varied from 25to 50 nm. Figure 1a shows the absorbance of suspension of CNPs in PEG, the absorbance of PEG and the absorbance of CNPs. The maximum absorption of fluorescent CNPs is at 230 nm. Figure 1b shows the photoluminescence spectra of CNPs obtained with two excitation sources with maximum intensity at 370nm and 420 nm, respectively. In the case of acetone the absorption peak of CNPs is shifted to330 nm but the emission spectra are quite similar although over 2 times weaker than those of carbon nanoparticles irradiated in PEG.

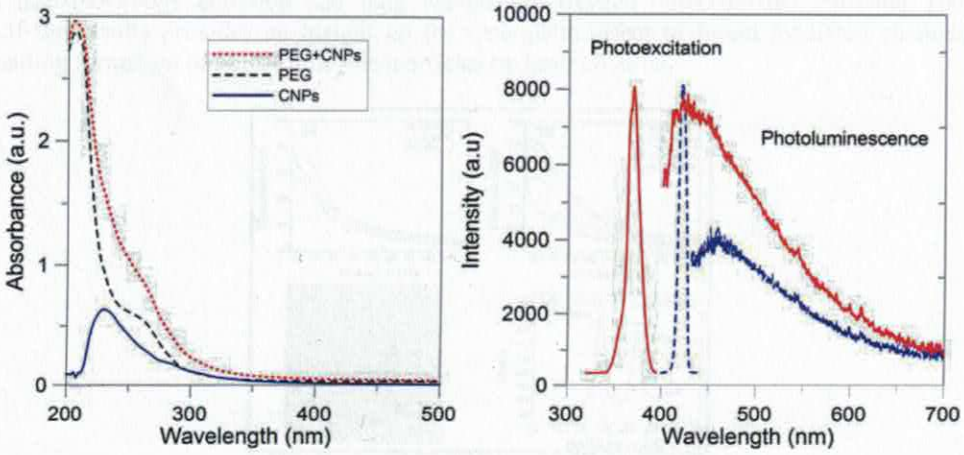

Fig.1(a,b)Optical properties of carbon nanoparticles (CNPs) suspended in PEG_{200}; a)absorbance of suspension of CNPs in PEG (dotted line), absorbance of PEG (dashed line), absorption of suspended CNPs (solid line), (b) photoexcitation and photoluminescence spectra of carbon nanoparticles (CNPs) suspended in PEG.

References

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