Nanostructured surfaces

Nonlinear optical characterization of different carbon allotropes

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We prepared and collected a series of quite different carbon materials in order to characterize them with sensitive nonlinear optical (NLO) technique that is based on the self-action of the picosecond range laser pulses at 1064 nm. The carbon materials, e.g. nanodiamonds (NDs), multiwall carbon nanotubes, graphitized carbons including nm constituents, and etc. can be involved in the production of the carbons interfaces for optoelectronic, spintronic and optical limiting application. The nanoscale and micrometer scaled carbon powders were prepared by various physical and chemical methods that including carbonization procedures conducted under the different temperature regimes. The resulted samples were characterized by X-ray powder diffraction, scanning electron microscopy, TEM imaginary; IR spectroscopy, thermal analysis, the grain size analysis and Brunauer-Emmet-Teller surface area measurements. The carbons are differing by the ratio of sp^2 to sp^3 carbon, and the production control with remote optical diagnostics seems to be informative in this vein [1, 2]. A special attention was paid to representatives of different carbon allotropes including graphite, thermally expanded graphite, carbon blacks, and NDs that are the most popular model objects, which physical properties are well documented.

It was shown that studied carbon allotropes demonstrate the different photodarkening efficiency with characteristic $\mathrm{Im}(\chi_C^{(3)}) \sim 10^{-9}$ esu in the initial peak intensity range < 10 MW/cm^2 that can be explained by different ratio of sp^2 to sp^3 hybridized carbon domains in the allotropes. The photobleaching response of NDs in this range was an exception and can be attributed to the sp^3 carbon hybridization. For the higher excitation level, the NLO response efficiency correlates with stacks size, being formed by graphene layers in the bulk of the studied materials.

1. *Papagiannouli I., Bourlinos A.B., Bakandritsos A., Couris S.* Nonlinear optical properties of colloidal carbon nanoparticles: nanodiamonds and carbon dots. // RSC Ads.-2014.-**4.**-P. 40152-601.
2. *Muhammad S., Xu H-L., Zhong R-L., Su Z-M., Al-Sehemic A.G., Irfan A.* Quantum chemical design of nonlinear optical materials by sp^2-hybridized carbon nanomaterials: issues and opportunities. *// J. Mater. Chem. C*.-2013. -**1**.-P.5439-49.