Spectroscopic characterization of nanodiamonds with sp2-sp3 graphene-like shell

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1. Introduction

Fluorescent nanodiamonds (FNDs) are promising objects for various applications spreading from biomedical ones, where FNDs are used as fluorescent labels for bioimaging and systems for drug delivery [1], to optical sensing of chemical reactions and controlling of environmental parameters such as temperature, pH, etc. FNDs exhibit a low level of toxicity and are biocompatible. However, spectroscopic properties of FNDs strongly depend on synthesis procedure. Precise determination of the origin and mechanisms of photoluminescence (PL) will allow more effectively using the specific features of FNDs in particular application areas.

2. Result and Discussion

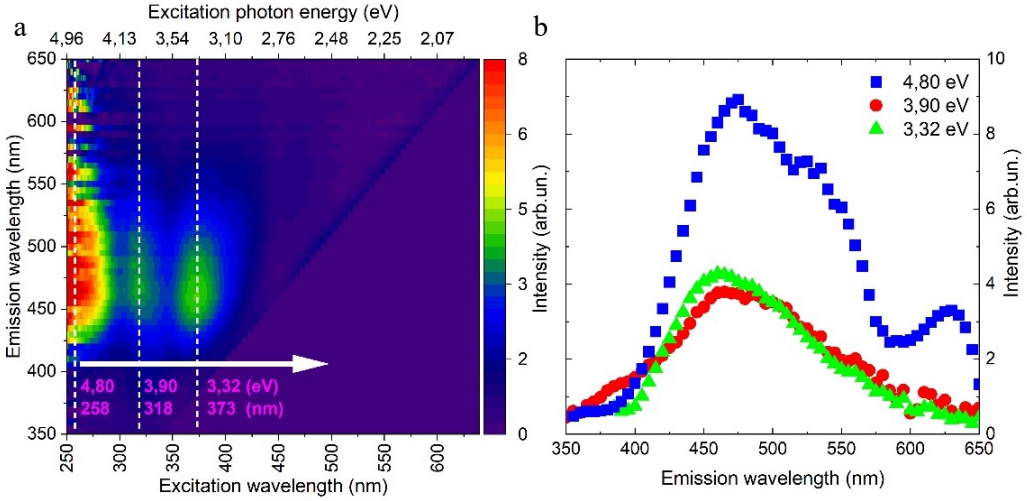

Fig. 1: a) PLE mapping and b) PL spectra for 258, 318 and 373 nm excitation wavelengths of 0.01% FND water solution

In the present work, high-purity and high-homogeneity solutions of FNDs (RayND-M, Ray Techniques Ltd) produced by laser synthesis were investigated. They have core-shell structure as they have diamond inner core (sp3 carbon atoms) and chemically active hybrid graphene-like outer shell (sp2 carbon atoms) with hanging bonds ended with functional groups.

On the photoluminescence excitation (PLE) mapping (Fig.1a) of 0.01% FND water solution, three areas of pronounced emission are present. For these areas, excitation photon energies tentatively correspond to 4.80, 3.90 and 3. 32 eV (Fig.1b). The first one (at 258 nm) is associated with $\pi \rightarrow \pi*$ transition of the C=C bond. The other two, less pronounced, around 318 and 373 nm, are more likely associated with the presence of oxygen functional groups (C=O/COOH) on hybrid graphene-like structures on the FND surface or related to lattice defects and impurities like in natural and synthetic diamonds [2]. These groups in line with heterogeneity of graphene-like sheets in the shell determine excitation dependent PL of FNDs.

3. Conclusions

Investigated FNDs are unique multifunctional nanoobjects, which have specific PLE properties and can be applied for e.g., multiwavelength imaging, pH-sensing through COOH groups presented on the FNDs surface.

4. Acknowledgement

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5. References

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