Enhanced light-matter interaction in plasmonic nanostructures

S.Gaponenko
B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

A general consideration of nanoplasmonic enhancement of light–matter interaction is proposed in terms of incident field concentration and photon density of states concentration providing a rationale for huge enhancement factors for Raman scattering and noticeable enhancement factors for luminescence. The proposed model sheds light on the so-called “hot spots” as such places on a nanotextured metal surface or near metal nanobodies where simultaneous spatial redistribution of electromagnetic field occurs both at the frequency of the incident primary radiation at the frequency of secondary radiation. Experimental performance of enhanced secondary emission for atomic, molecular systems, semiconductor quantum dots and inorganic microcrystals using multilayer and spatially organized metal-dielectric nanostructures is discussed in detail.

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Luminescent nanodiamonds of divers origin

I. Vlasov
General Physics Institute, Russian Academy of Sciences, Russia

For the last decade an interest to the luminescent nanodiamond has multiply increased. This is explained by promising results on use of luminescent NDs as a source of a single-photon emission for quantum information technologies and, alternatively, as a bright light source applicable for biolableling. The brightest color centers used for a production of the luminescent nanodiamond are nitrogen-vacancy (NV) and silicon-vacancy (SiV) centers.

We studied the color center photoluminescence in CVD, detonation and meteoritic nanodiamonds (ND). It was demonstrated that the luminescent SiV centers are efficiently produced and are thermodynamically stable in 3-5-nm diamond crystallites produced by CVD technique. Representative classes of NDs produced by detonation shock wave conversion of diferent carbon precursor materials have been systematically investigated. There was shown that (i) ND particles larger than 30 nm may contain in situ produced optically active NV centers, (ii) in ND produced from explosives, NV centers are detected only in ND produced by wet synthesis, (iii) NDs synthesized from a mixture of graphite/hexogen have the largest concentration of NV centers among all studied NDs. Recently, SiV luminescence was found in meteoritic nanodiamond particles with a mean size of 1.5-2 nm. This finding opens the door to non-perturbative fluorescent probes as markers in microscopy and sensing, and provides a remarkable fingerprint for identification of nanodiamonds in astrophysical environment.

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