Luminescent Detonation Nanodiamond

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Abstract: Luminescent nanodiamond has recently gathered significant interest as a potentially excellent optical label for biological imaging due to merits such as photostability and bio-compatibility. While substantial progress towards this application has been achieved with diamond particles as small as 35nm [1, 2], the need for sub-10nm luminescent nanodiamonds is well recognised [3]. Achieving a sub-10nm size enables nanodiamonds to be used for intracellular labelling of single biomolecules. Current labels are generally unsuitable for such experiments as they cause steric perturbations or require complex delivery techniques. We report on new methods for the production of luminescent detonation nanodiamonds as small as 5nm.

Vacancies were created in the diamond lattice using Nitrogen and electron irradiation and subsequent thermal annealing was done at temperatures between 400°C and 700°C in air or vacuum. A novel method of introducing colour centers into gram-quantities of detonation nanodiamonds is described, allowing luminescent nanodiamonds to be produced easily in quantities which are useful for biological experiments. Such luminescent 5nm diamond crystals are ideally suited as optical labels for biological imaging and also for gene delivery.

Photo-luminescence spectra, shown in figure 1, and photostability data suggest the formation of Nitrogen-Vacancy defect centers. These results also suggest the presence of substitutional Nitrogen atoms in the core of detonation nanodiamond.

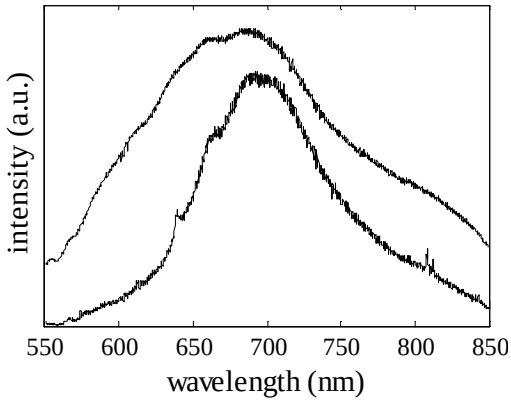

Fig 1. Luminescence spectra of 5nm (top) and 55nm nanodiamonds (bottom).

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[3] K.B. Holt, "Diamond at the nanoscale: applications of diamond nanoparticles from cellular biomarkers to quantum computing", Phil. Trans. R. Soc. A, **365**, 2845-2861 (2007)