Evaporation of detonation nanodiamonds

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Diamond nanoparticles have drawn significant attention from a wide range of researchers for use in a variety of applications including, plating, lubricating oils, polishing, and biomedical devices.[1] The optical properties of the nitrogen-vacancy colour centre,[2] which can undergo strong spin-sensitive optical transitions under ambient conditions, makes them attractive for example for quantum optics[3] and biolabelling.[4] Until now one of the main approaches for producing large quantities of sub 10 nm nanodiamonds has been a top-down approach involving milling luminescent high pressure high temperature (HPHT) microdiamonds into 7 nm particles and forming water dispersible colloidal quasi-spherical nanodiamonds.[5]

An alternative approach for producing nanodiamonds is by direct treatment of detonation nanodiamond powder. The typical worldwide output by this approach is several tonnes each year. However, a major drawback of this method is that the individual particles agglomerate into clusters ranging from hundreds of nanometres to several micrometres in diameter owing to strong interparticle bonding and the presence of soot-like structures surrounding the nanodiamond crystals.[6] Since the nature of this material has the potential to limit the range of viable nanodiamond applications, many groups have investigated routes towards separating persistent nanodiamond agglomerates.

In this work we report a method for the complete separation of detonation nanodiamond agglomerates yielding well-dispersed nanodiamond particles passivated with surface alkyl groups in solution and powder form. Powder of isolated diamond nanoparticle than can be re-suspended, deposited on any substrate and then evaporated. This evaporation processing route could open a way to nanodiamond size-selection and hence new applications.

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