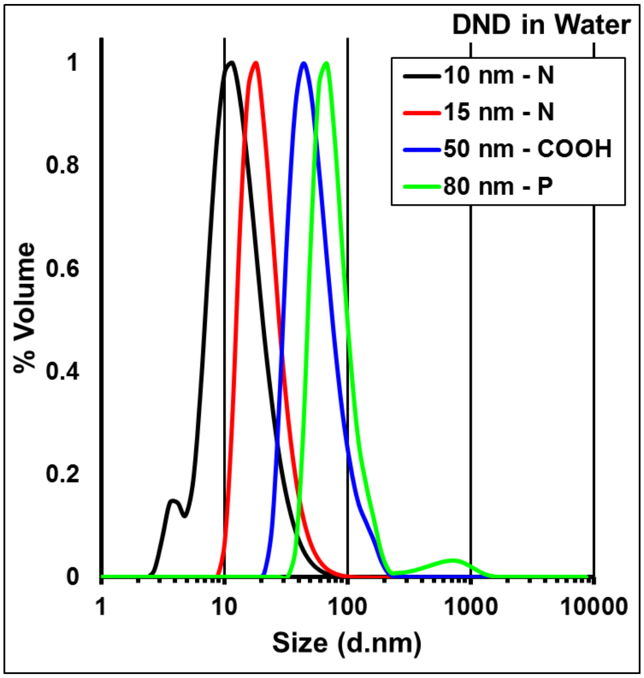
10-80 nm Detonation ND Suspensions

ADÁMAS nano
Brilliant Diamond Solutions

Product Sheet

Colloidal suspensions of detonation nanodiamond (DND) in both water and a variety of organic solvents have a wide range of uses, including: (1) drug delivery research, (2) nanocomposite strengthening, (3) electroplating, (4) polishing, and (5) oil and fuel additives. Adámas offers a selection of nanodiamond particle suspensions ranging in size from the fully deagglomerated monodispersed 4-5 nm primary particles up to 200 nm tight aggregates of the primary particles. This brochure provides characteristics for 10 – 80 nm nanodiamond suspensions.

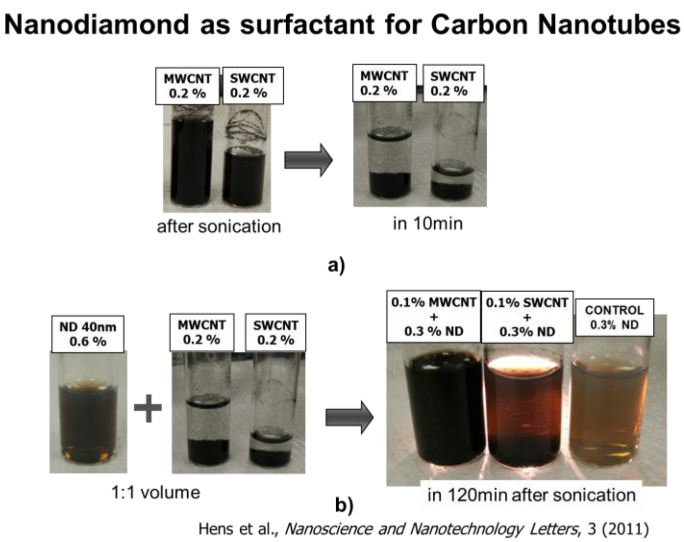
Technical Characteristics



Particles with sizes above the primary 5 nm particles of detonation nanodiamond do not exist as monolithic diamond particles. This is an important distinction from other nanoparticle systems and even other types of diamond (such as particles produced by high pressure high temperature (HPHT) method). Detonation nanodiamonds at these sizes exist as tight, semi-porous clusters of 5 nm primary particles. Adámas offers 10 and 50 nm aggregates of carboxylated DND (negatively charged with zeta potential -45 mV) as well as 80 nm positively charged product with polyfunctional groups (with zeta potential +40 mV). Dynamic light scattering based size distributions for these products are shown in Fig. 1. All of these products are sold as suspensions in water. Additional sizes can be obtained upon request.

Figure 1: Volumetric DLS size distributions of DND suspensions in water.

Featured Application: Nanodiamond as a surfactant for carbon nanotubes



ND smaller fractions are excellent surfactants for other nanocarbon materials, such as carbon nanotubes and graphene (U.S. patents 8,070,988 & 8,308,994). Most sp^2 carbon nanostructures including carbon nanotubes are hydrophobic and unstable in polar solvents without special surface functionalization (Fig. 2a). Nanodiamonds however can be stabilized colloidal suspensions of multi-wall carbon nanotubes (MWCNTs) and single-wall carbon nanotubes (SWCNTs) (Fig. 2b).

Figure 2: Photographs showing the colloidal stability of suspensions for SWCNT and MWCNT in water without (a) and with DNDs (b).

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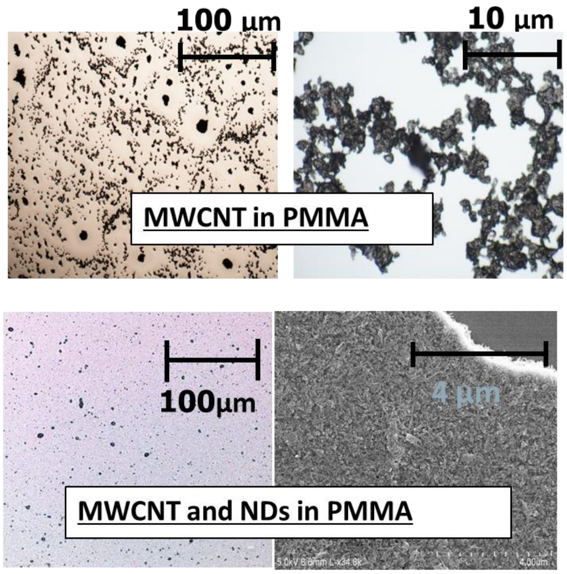
Featured Application: Nanodiamond as a surfactant for carbon nanotubes

By adding suspensions of nanodiamond particles with either positive or negative zeta potential to otherwise unstable aqueous suspensions of CNTs and sonicating the nanocarbon mixture for a few minutes, suspensions of SWCNTs and MWCNTs have been produced maintaining colloidal stability for several weeks and months, correspondingly. Nanodiamond/ carbon nanotubes mixtures are also stable in methanol, isopropanol, DMSO, and DMF.

DND-assisted Dispersion of CNTs in Polymers



Gokhale et al., *Journal of Microelectromechanical Systems* (2014)

The mechanism for nanodiamond-assisted dispersion of carbon nanotubes and graphene includes formation of π–π bonding between sp^2 patches on nanodiamond and sp^2 carbon atoms on CNT and graphene surfaces, decorating the surfaces. Since nanodiamond particles are highly charged in polar solvents, the sp^2 nanocarbons interdigitated with charged nanodiamond particles also acquire high repulsive forces and resist agglomeration. During sonication nanodiamonds also cause debundling of CNTs or graphene constituents. Charged nanodiamond particles can be used to effectively and uniformly disperse the carbon nanotubes or graphene in a polymer matrix, leading to a very homogenous film (Fig. 3)

Figure 3: Excellent uniformity of CNT distribution within a polymer film can be obtained with assistance of NDs.

Product	Suggested Application	Sold As	Catalogue No.
10 nm – N Negative zeta potential	NanocompositesDrug Delivery Polishing	10 mg/mL in DI water	ND10nmNH2O100ml
			ND10nmNH2O500ml
			ND10nmNH2O1000ml
80 nm – P Positive zeta potential	NanocompositesDrug Delivery Polishing Electroplating	100 mg/mL in DI water	ND80nmPH2O100ml
			ND80nmPH2O500ml

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