Nanodiamond Modification and Evaluation of Colloid Stability

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Nanodiamond's (ND) exceptional physiochemical properties are largely responsible for the growing popularity of these particles in nanotechnology research. Though ND particles have relatively high surface areas (300-400m^2/g) their primary distinctiveness comes from their ability to possess a large number and assortment of surface groups. Such chemistries can be tailored to meet specific end use requirements of the ND. In manipulating these groups, both highly positive and negative surface charges can be acquired and maintained while in aqueous solution. Over long durations, highly charged NDs remain well suspended and many types show exceptional dispersivity over a wide pH range. Furthermore, supplemental studies via animal and cytotoxicity research revealed NDs are both biocompatible and non-toxic, critical information for a biomaterial. Current research focuses on ND's biomedical use in enterosorbent applications, wherein NDs are used to adsorb specific toxins in the gastrointestinal tract. For enterosorbent treatment, each of the aforementioned properties are significant in developing the ND.

Enterosorbent development can be complicated as NDs purchased directly from vendors, in most cases, require modification due to inhomogeneous properties. Inconsistencies of NDs can be traced back to the methods used to produce the nanoparticles. NDs formed by detonation of carbon-containing explosives require purification from the soot and removal of metallic impurities, all which are completed at an industrial scale. Consequentially, NDs will have different surface chemistries and various aggregate sizes causing various levels of dispersivity and stability among ND colloids.

ND modification to overcome inconsistencies and/or modify ND for specific applications can be completed simply by chemical or physical means. Approaches include plasma treatments, size fractionalization, or silane surface coatings. Assessment of each method is characterized by zeta potential measurements at neutral pH, this allows for an easy understanding of the suspension's stability. Advanced experiments of titration over a wide range pH verified that relatively high zeta potential can be preserved, which is important for NDs passing through the gastrointestinal tract.

Adsorption of aflatoxin B1, a carcinogenic byproduct of mold growth, by NDs will be the focus of future studies. Initial experiments have already indicated that the ND type and modification method influence the adsorption capacity of the ND. Current research is determining how controlling the surface chemistry and stability of the ND may increase its adsorption efficiency.

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