SELF-SUPPORTING NANODIAMOND GELS: ELUCIDATING COLLOIDAL INTERACTIONS THROUGH RHEOLOGY

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While ND represents a promising class of nanofiller due to its high surface area, superior mechanical strength, optical transparency, tailorable surface functionality and biocompatibility, much remains unknown about the behavior of ND dispersions and their responses to various processing conditions. We hypothesize that controlling interactions in ND dispersions will lead to highly functional systems with tunable modulus and shear response. Steady and dynamic rheology techniques are thus employed to systematically investigate nanodiamonds dispersed in model polar and non-polar media and examine the microstructure and concomitant rheological behavior. We find that low concentrations of ND form gels almost instantaneously in a non-polar media, the strength of which follow a power-law behavior. In contrast, ND's in polar media show a time-dependent behavior with the modulus increasing with time. We attribute the difference in behavior to variations in inter-particle interactions as well as the interaction of the ND with the media. Large steady and oscillatory strains are applied to ND colloidal gels to investigate the role of shear in gel microstructure breakdown and recovery. For colloidal gels in non-polar medium, the incomplete recovery of elastic modulus at high strain amplitudes indicates dominance of particle-particle interactions; however, in polar media the complete recovery of elastic modulus even at high strain amplitudes indicates dominance of particle-solvent interactions. These results taken together provide a platform to develop self-supporting gels with tunable properties in terms of ND concentration, and solvent typ