A REVIEW ON METHODS AVAILABLE FOR DOPING OF HIGH ENERGY BORON PARTICLES INTO LIQUID FUELS

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Abstract

Metals and metalloids such as Fe, Al, Be, B, Li, Mg, Ti are used as high energy materials as they possess higher gravimetric and volumetric heating values than liquid fuels. Boron possesses the highest volumetric (136 kJ/cm3) heating values among most of the preferred metal particles however it is second highest in gravimetric (58 kJ/g) heating values. This review highlights different successful methods of introduction of boron/aluminum particles in liquid fuels maintaining its suspension stability by using various surfactants or functionalization by different groups of ligands. Commercially available boron powder (nominal diameter 800 nm) contains coarser and mixed-size boron particles that require long milling times or a two-step milling process before final sample preparation. Suspension stability of boron particles can be achieved by using various classes of surfactants or techniques involved in surface modification of particles. Surfactants that are commonly used are oleic acid, sorbitanoleate, tween80, etc. Sorbitan oleate is now a days gaining popularity as the best stabilizer for this type of fluid preparation.

Another effective ligand (amphiphilic) that is Trioctyl phosphine oxide (TOPO) links with fuel with its hydrophobic chain (long carbon chain) and nanoparticles with its polar head group. Recently some studies employed the capping of nanoparticles with ionic liquids (ILs) like (1-methyl-4-amino-1,2,4-triazoliumdicyanamide ([MAT][DCA]),1-butyl-3-methylimidazoliumdicyanamide ([BMIM][DCA]) and Dicyanamide-based Dicationic Ionic Liquid (DCIL). Capping of nanoparticles with organic chemicals is commonly done by Silane, Polymethyl acrylic acid (PMAA), Octyloxy, etc. An attempt to coat the surface of boron with an energetic polymer (Glycidylazide polymer) was also made recently by many researchers. These methods are some of the best approaches to attain longtime stability of high energy particles doped liquid fuel. After a thorough study of literature, the available techniques already tried and tested by different research groups have been presented.

Keywords: MNPs, BNPs, TOPO, ILs, [MAT] [DCA], [BMIM] [DCA], DCIL, PMAA, GAP