

Synthesis of Metallic Nanoparticles using a Submerged Pulsed Arc

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1. General

We describe the use of a submerged pulsed high-current arc for the controllable preparation of Fe-Bi nanoparticles using Fe and Bi electrodes. The arc was produced in D.I. water and the nanoparticles were removed from the reaction chamber by the liquid flow. The nanoparticles were separated and collected depending on their characteristics (magnetic, heavy or light). It was found that the heavy and the light nanoparticles were very similar. The structure and the morphology of the nanoparticles were studied using SEM, EDS, XRD and optical absorption. We observed an average particle size between 5 and 20 nm, a high percent of oxygen, a low percent of bismuth in the magnetic nanoparticles and no iron in the heavy and the light

nanoparticles. Larger bi-metal spheres of approximately 1.0 micron diameter were observed that had Fe cores covered with Bi. The temporal variation of the arc was studied using a high speed Phantom camera. Both direct observation and shadowgraphy using an expanded 532nm laser were performed. The short time volume and the speed of the bubble explosion increased with the energy applied to the system, and while the volume grew linearly with time, the speed of the expansion was superlinear. Finally, longer times we observed a somewhat complicated the bubble evolution: first the bubble expanded, reached an equilibrium state, it then contracted before again expanding, and then finally it dispersed.