

Determining Aqueous Fullerene Particle Size Distributions by
Asymmetric Flow Field-Flow Fractionation (AF4) without Surfactants

Carl Isaacson,^a Xin Ma,^b Bethany Wigington,^c Tiantiana Burns,^c
Dermont Bouchard^{b*}

^aNRC Associate, ^bUSEPA Office of Research and Development, ^cStudent Services
contractor, Athens, GA

*Corresponding author, phone 706-355-8333, email: bouchard.dermont@epa.gov

Abstract

To determine the behavior of nanoparticles in environmental systems, methods must be developed to measure nanoparticle size. Asymmetric Flow Field Flow Fractionation (AF4) is an aqueous compatible size separation technique which is able to separate particles from 1 nm to 10 μ m in diameter based on differences in particle diffusion coefficients. Many AF4 size separation methods use surfactants to ensure particle stability; however, the use of such surfactants may alter particle characteristics. A surfactant-free AF4 method was developed to size fractionate aqueous C₆₀ aggregates (aqu C₆₀) generated by sonication in deionized water. Aqu/nC₆₀ aggregates ranged in size from less than 100 nm to 450 nm (the filter cutoff), as determined by dynamic light scattering in flow through mode and further corroborated by batch analysis with dynamic light scattering and electron microscopy. Mass determination by LC-MS showed less than 15% of the aqu C₆₀ had diameters less than 100 nm, while 50% of the mass of the aqu C₆₀ had diameters between 140 and 250 nm. Additionally, the use of 1 mM NaN₃ resulted in 40% of the aqu/nC₆₀ being deposited in the AF4 channel and use of channel flow splitting increased detector response, though not to the extent expected.