

Light-initiated Transformation of C₆₀ Clusters in Water

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Although Buckminster fullerene (C₆₀) has an extremely low water solubility (~8 ng/L), the formation of stable clusters (aqu/nC₆₀) not only greatly increases the mass of C₆₀ dispersed in water, but also alters its physicochemical properties. This research focused on investigating the light-initiated transformation processes of aqu/nC₆₀ aggregates in water. The irradiation kinetics of aqu/nC₆₀ with simulated solar and monochromatic irradiation were investigated. The direct photoreaction of aqu/nC₆₀ over a 3-day period exhibited first-order kinetics with reaction quantum yields of $1.48 (\pm 0.05) \times 10^{-5}$ and $2.95 (\pm 0.13) \times 10^{-5}$ at 366 and 435 nm, respectively. Following irradiation by simulated solar radiation the fluorescence excitation-emission matrix scans (EEMs) of the aqueous phase of aqu/nC₆₀ extracted with toluene showed an initial increase (7 days) and an ultimate decrease (12 days) with the emission peak shifted to a shorter wavelength. This result displays the same pattern observed with fullerenol, a hydroxylated C₆₀, under simulated solar irradiation, suggesting that the photolysis of aqu/nC₆₀ leads to formation of hydrophilic functional groups (i.e. -OH or -C=O). MALDI-TOF-MS of both the toluene and water phase of C₆₀ extracted with toluene also implies the possible formation of more hydrophilic products following irradiation.