Redispersion and Self-Assembly of C\textsubscript{60} Fullerene in Water and Toluene

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Abstract

This work aims at assessing the influence of two different solvents, bidistilled water and toluene, on dispersions of carbon-based engineered nanomaterials, fullerenes, and their self-assembly behavior. The obtained self-assembled carbon-based materials were characterized using UV−vis spectrophotometry and transmission electron microscopy techniques. The results obtained were unexpected when toluene was used for dispersing fullerene C\textsubscript{60}, with the formation of two different types of self-assembled structures: fullerene C\textsubscript{60} nanowhiskers (FNWs) and a type of quasispherical nanostructure. The FNWs ranged between 1 and 6 \(\mu\)m in length, whereas the quasispherical fullerene C\textsubscript{60} nanoaggregates ranged between 10 and 50 nm in diameter [1]. Aggregates obtained in toluene showed a well-formed crystal structure. When using water, the obtained aggregates were amorphous and showed a no well-defined shape. Their sizes ranged between 20 and 40 nm for nanosized structures and between 0.4 and 4.8 \(\mu\)m for micron-sized self-aggregates. Previous work [2] underlined that C\textsubscript{60} shows very low solubility in water, whereas the solubility of C\textsubscript{60} in toluene is 2.8 mg/mL, which is an important factor to take into account in our experiments and in further studies [3].

References

[1] Cid, A. et al., ACS Omega, 2 (2017), 2368–2373.
[2] Hughes, J.B. et al., Environ. Sci. Technol. 39 (2005), 4307–4316.
[3] Sukant, K. T. et al., Chem. Mater. 10 (1998), 2058–2066.

Figures

Figure 1: Graphical abstract: dimmer formation of FC\textsubscript{60} redispersed in toluene, core-shell structure formation of FNWs, TEM, HRTEM images, growth indexes confirming fcc and bct crystalline structures.

Figure 2: UV−vis normalized absorbance spectra of fullerene C\textsubscript{60} in toluene at several concentrations. Inset: Enhanced image of the peak found at 407 nm. Naked-eye observation of C\textsubscript{60} redispersed in toluene.
