Single-Walled Carbon Nanotube Dispersant
Photochemically Controllable Dispersion and Aggregation

Advantages

• Strong interaction to the surface of single-walled carbon nanotube (SWCNT)
• Positive charge on the stilbene core enables SWCNT to disperse in aqueous solution
• UV irradiation makes closure of the stilbene moiety and elimination from the SWCNT surface which enables SWCNT to aggregate
• Precisely controllable dispersion by photo irradiation
• After the aggregation, the dispersant can be easily removed by filtration, etc.

Possible Application

• Purification of SWCNT by combining dispersion in solution, centrifugation and photo-induced aggregation
• Development of new composite material for CNT-based film and paint

References

4,4’-[1,2-Ethenediylbis(4,1-phenyleneiminocarbonyl)]bis(N-butyl-N,N-dimethylbenzenemethanaminium) Dichloride

This product was commercialized by collaboration with Dr. Yoko Matsuzawa.
**Single-Walled Carbon Nanotube Dispersant**

(1) Preparation of dispersions (Low power sonication)

3.6 mg of E1127 was dissolved in 3 mL of pure water (18.8 MΩ·cm, TOC < 3 ppb) or D2O using a glass vial (ca. 0.12 wt%). The solution was then sonicated (80 W, 35 kHz) at room temperature. Heating by a dryer is also a useful method for solvation. 1.96 mg of SWCNTs was added into the solution of E1127. The E1127/SWCNT mixture was sonicated (80 W, 35 kHz, 1 h) at room temperature. The black-colored dispersion was then centrifuged to remove impurities such as amorphous carbons and metal particles (28500 x g, at 22 ºC, 3 hrs). Upper 70 % of supernatant was corrected as a well-dispersed SWCNT dispersion.

![Figure 1. UV-vis-NIR absorption spectra of the E1127/SWCNT dispersion treated by low power sonication (in D2O, light pass length 0.5 mm)](image1)

(2) Preparation of dispersions (High power sonication)

10 mg of E1127 was dissolved in 20 mL of pure water (18.8 MΩ·cm, TOC < 3 ppb) or D2O using a glass vial (ca. 0.05 wt%). The solution was then sonicated (80 W, 35 kHz) at room temperature. Heating by a dryer is also a useful method for solvation. 7.0 mg of SWCNTs was added into the solution of E1127. The mixture was sonicated (80 W, 35 kHz, 1 h) at room temperature. Subsequently, the dispersion was subjected ultrasonication (60 W, 19 kHz, 4 hrs) at room temperature. The black-colored dispersion was then centrifuged to remove impurities such as amorphous carbons and metal particles (28500 x g, at 22 ºC, 3 hrs). Upper 70 % of supernatant was corrected as a well-dispersed SWCNT dispersion.

![Figure 2. UV-vis-NIR absorption spectra of the E1127/SWCNT dispersion treated by high power sonication (in D2O, light pass length 0.5 mm)](image2)

(3) Photoirradiation and precipitation

A well-dispersed SWCNT dispersion was transferred to a dialysis tube (cutoff MW of 1000) to remove excess amount of E1127 from the dispersion. The tube filled with the dispersion of E1127/SWCNT system was put into a glass beaker with 3 L of pure water (18.8 MΩ·cm, TOC < 3 ppb) and was stirred overnight. The dialyzed dispersion was transferred into quartz cells and irradiated by an LED light source (365 nm, 100 mW/cm²) for several hours under magnetically stirring. After 3 hrs of light irradiation, precipitation of SWCNTs was completed for the dispersion treated with low power sonication. The SWCNT dispersion prepared using high power sonication took 7 hrs to recognize precipitation.

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