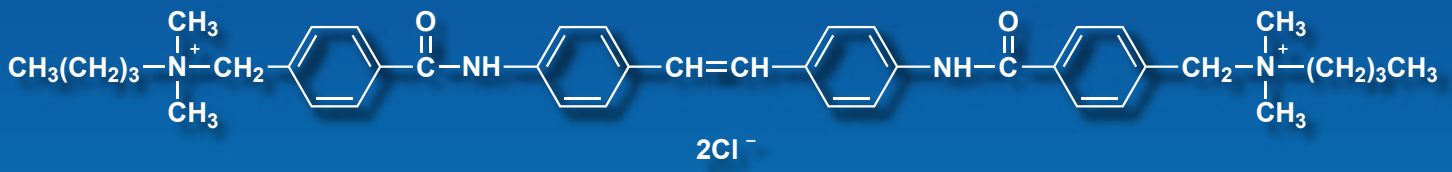
MATERIALS

Single-Walled Carbon Nanotube Dispersant

Photochemically Controllable Dispersion and Aggregation

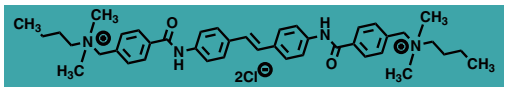


4,4'-[1,2-Ethenediylbis(4,1-phenyleneiminocarbonyl)]-bis(*N*-butyl-*N*,*N*-dimethylbenzenemethanaminium) Dichloride

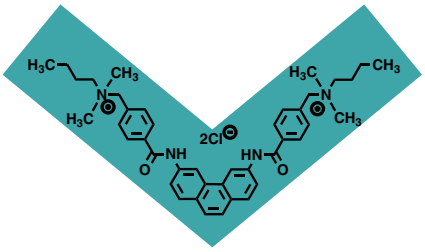
1g [E1127]

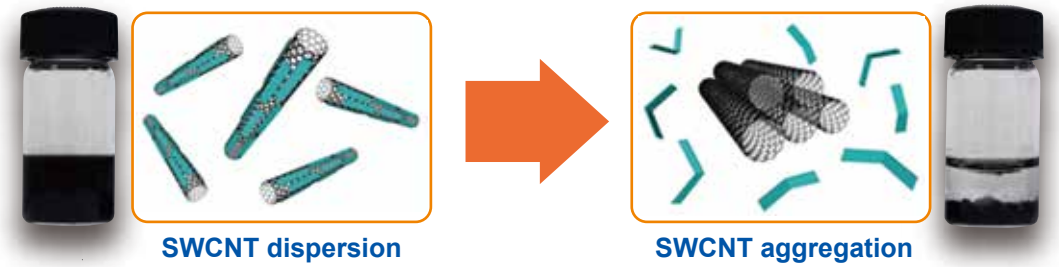
Advantages

- 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.



[E1127]





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 Y. Matsuzawa, M. Yoshida, H. Ohyama, H. Kato, Patent JP5552641.
Y. Matsuzawa, M. Yoshida, *Adv. Mater*. **2011**, *23*, 3922. https://doi.org/10.1002/adma.201101960
Y. Matsuzawa, M. Yoshida, *J. Phys. Chem. C* **2014**, *118*, 5013. https://doi.org/10.1021/jp411964z

This product has been commercialized under the instruction of 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 D_2O 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 hours) 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 hours). Upper 70 % of supernatant was corrected as a well-dispersed SWCNT dispersion.

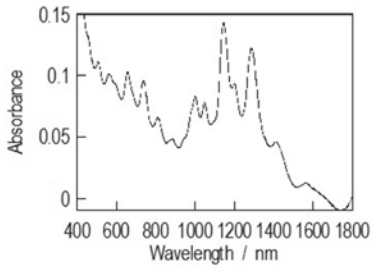


Figure 1. UV-vis-NIR absorption spectra of the E1127/SWCNT dispersion treated by low power sonication (in D_2O, light pass length 0.5 mm)

(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 D_2O 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 hours) at room temperature. Subsequently, the dispersion was subjected ultrasonication (60 W, 19 kHz, 4 hours) 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 hours). Upper 70 % of supernatant was corrected as a well-dispersed SWCNT dispersion.

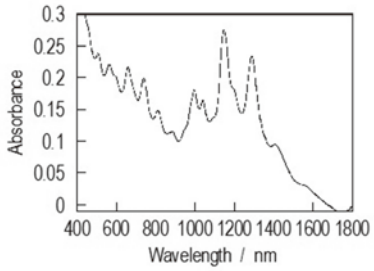


Figure 2. UV-vis-NIR absorption spectra of the E1127/SWCNT dispersion treated by high power sonication (in D_2O, light pass length 0.5 mm)

(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/cm^2) 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 hours to recognize precipitation.

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