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XAFS Study of Dipersibility of Iodine-doped Carbon Nanotubes in Water

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1 Introduction

We have developed very simple electrochemical iodine doping method to encapsulate iodine molecules into single-walled carbon nanotubes (SWCNTs). It was found that the electric conductivity of SWCNTs is drastically improved by iodine encapsulation because many hole careers are introduced. It was also found that the SWCNTs encapsulating iodine molecules (I@SWCNTs) are well dispersed in water at low temperature.[1] However, the reason why the dispersibility of I@SWCNTs changes with temperature has not been understood well. In order to clarify the reason, we performed XAFS measurements of I@SWCNTs at several temperatures.

2 Experiment

SWCNTs (Meijo Nano-Carbon, SO type) having mean tube diameter of ca. 1.5 nm were produced by arc-discharge method. Iodine encapsulation treatments were done in an electrochemical cell consisting of SWCNT electrodes and NaI aq. electrolyte. Iodine L-edge XAFS measurements of I@SWCNTs at several temperatures were done at BL-9C. Low temperature Raman measurements were also performed using a JASCO NRS-3300 spectrometer and a Linkam 10036L temperature control stage.

3 Results and Discussion

Fig. 1 shows I L-edge XANES spectra of several kinds of materials including iodine. The spectral features especially in higher energy side of I@SWCNTs at room temperature and 0ºC are quite different. At this moment, we could not explain the difference. We should perform more experiments (e.g. I K-edge EXFAS study) to understand the difference. On the other hand, as shown in Fig. 2, it was found by Raman measurements that the relative intensity of iodine Raman peaks observed in low wavenumber region to G-band peak of SWCNT at around 1600 cm^{-1} increased with decreasing temperature. It indicates that the reaction ($I_2 + I_3^- \rightarrow I_5^-$) would be promoted at low temperature. This hypothesis is supported by that the G-band peak position at low temperature was shifted toward higher wavenumber side.

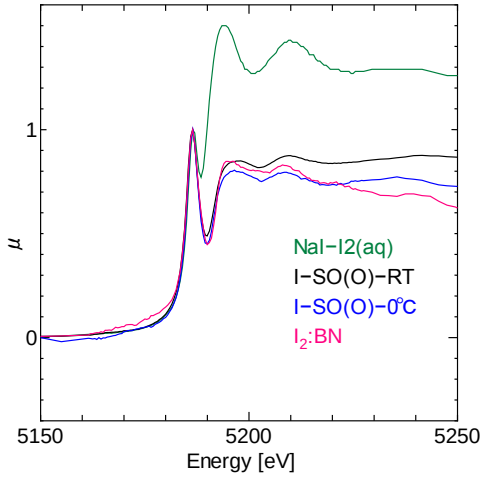

Fig. 1 The observed I L-edge XANES spectra of several kinds of materials including I@SWCNTs at room temperature and at 0 ºC.

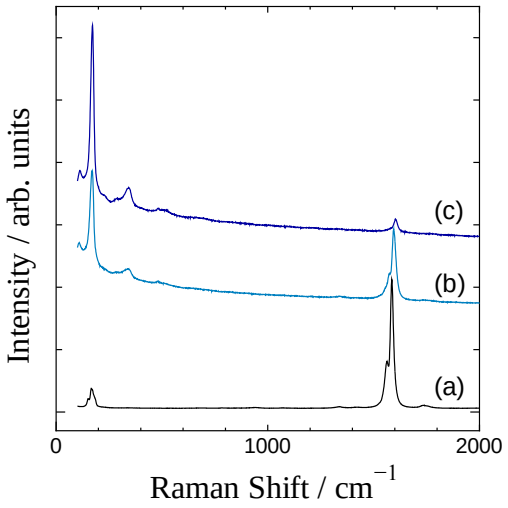

Fig. 2 Raman spectra of pristine SWCNT and I@SWCNT at room temperature.

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Reference

[1] H. Song, *et al*, *Phys.Chem.Chem.Phys*, **15**, 5767 (2013).

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