

Supplementary information

Supplementary Figures.

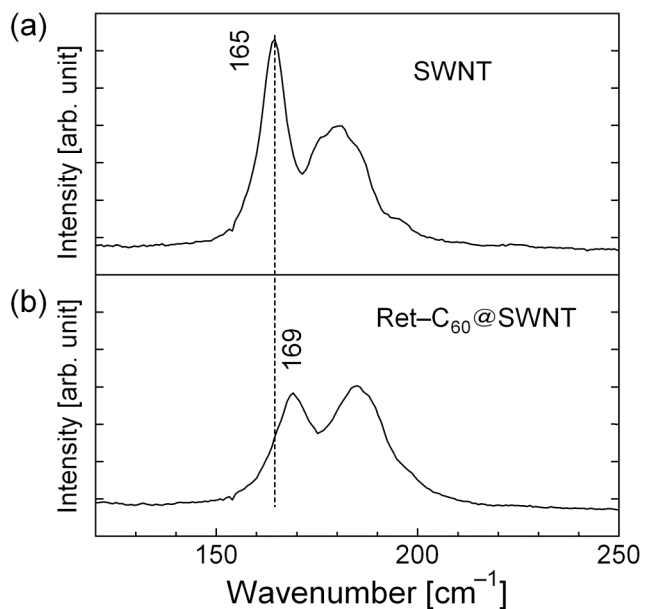


Figure S1. The radial breathing mode (RBM) of SWNTs before (a) and after (b) the encapsulation of Ret-C₆₀. The line-shape of RBM modes for Ret-C₆₀@SWNTs is remarkably different from that for SWNTs, suggesting that the Ret-C₆₀ molecules were encapsulated inside the nanotubes.

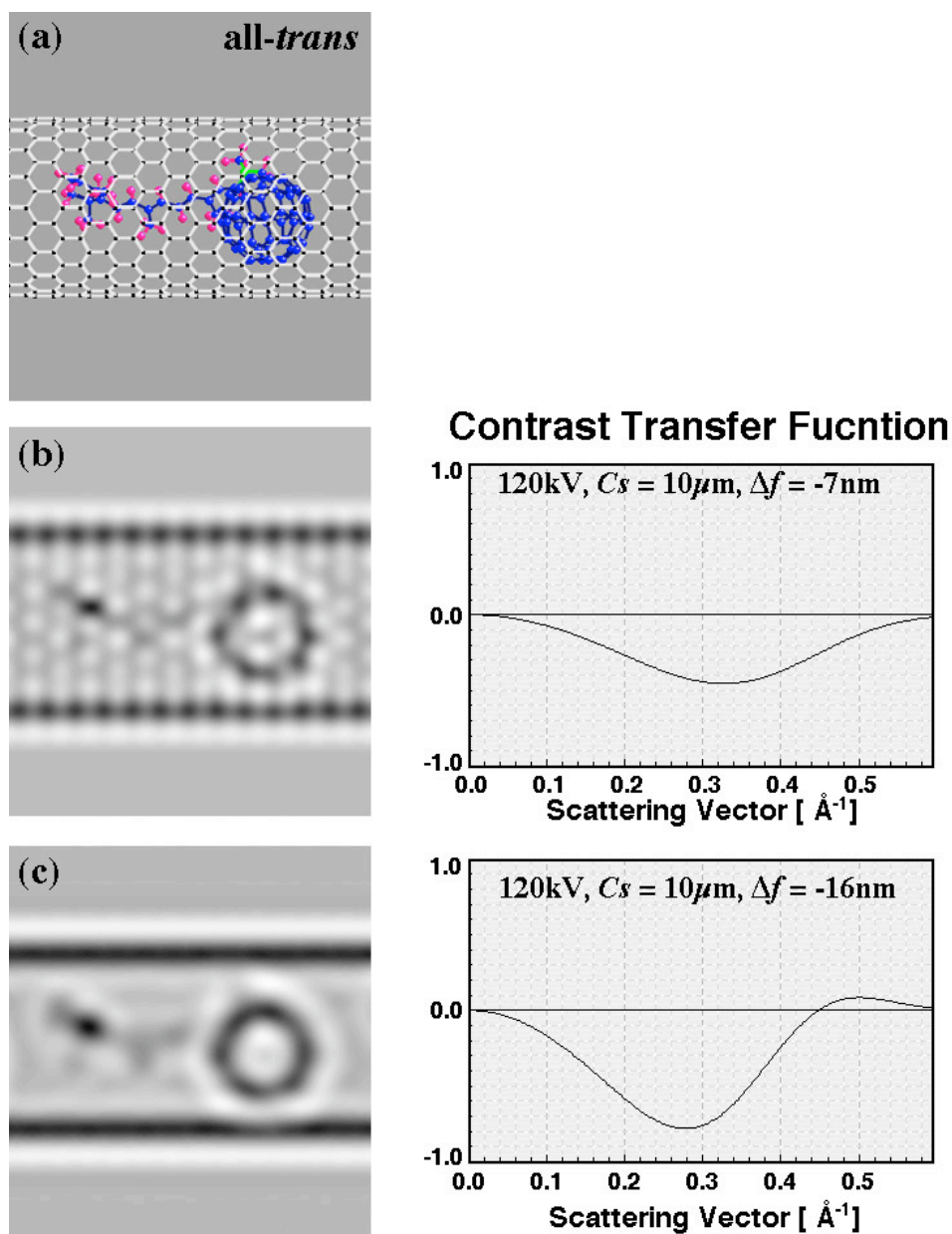


Figure S2 The image simulations for the Ret- C_{60} molecules inside the SWNTs at the different defocus conditions ($\Delta f = -7\text{ nm}$ and -16 nm) at 120kV accelerating voltage with the $C_s \sim 10\mu\text{m}$. With the -16 nm defocus condition, the contrast of the retinyl group can be enhanced in contrast to the graphene network of SWNT wall.

Supplementary Movies

Sequential HR-TEM images are attached as GIF files. Each frame was recorded in 0.5 sec exposure time. The GIF movies are therefore 5 times faster than the real-time recording so that the dynamic behaviors are much easier to be recognized by eye.

Movie 1a (movie1a.gif)

A movie file shows the retinal chromophores moving during the observations (corresponding to the time-averaged HR-TEM image in Fig. 3a). One of the rerinyl groups is fixed to the tube wall (the left one), the second one from the left can be a *cis* retinal.

Movie 1b (movie1b.gif)

A movie file shows the retinal chromophores moving during the observations (corresponding to the time-averaged HR-TEM image in Fig. 3b). One of the rerinyl groups is fixed (fourth one from the top, left side), the others are continuously moving among the C₆₀ markers.

Movie 1c (movie1c.gif)

A movie file shows the retinal chromophores moving during the observations. One of the rerinyl groups is fixed to the tube wall (the left one), the second one from the left can be a *cis* retinal.

Movie 1d (movie1d.gif)

A movie file shows the retinal chromophores moving during the observations.

Movie 1e (movie1e.gif)

A movie file shows the retinal chromophores moving during the observations.

Movie 2a (movie2a.gif)

A movie file shows a conformation change and/or rotational motion of *trans*-retinal. A cyclohexene at the tip-end is also visible. See also the Fig. 4a for the sequential HR-TEM images.

Movie 2b (movie2b.gif)

A movie file shows a conformation change and/or rotational motion of *trans*-retinal. See also the Fig. 4b for the sequential HR-TEM images.

Movie 2c (movie2c.gif)

A movie file shows a conformation change and/or rotational motion of *cis*-retinal. See also the Fig. 4c for the sequential HR-TEM images.

Movie 2d (movie2d.gif)

A movie file shows a flip motion of *cis*-retinal. See also the Fig. 4d for the sequential HR-TEM images.

Movie 2e (movie2e.gif)

A movie file shows a conformation change of the cyclohexene of *trans*-retinal.