

Fluorescence from a gelatin-based film containing isolated and orientated single-walled carbon nanotubes

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We have developed a technique to fabricate a gelatin thin film that contains orientated and individually dispersed single-walled carbon nanotubes (SWNTs). HiPco SWNTs ultrasonically isolated in surfactant-D₂O solution [1] were mixed with gelatin, and the gelatin-SWNTs solution was spread over a SiO₂ substrate by sliding a wire-bar uniformly over the surface in a single direction. A wire-bar is a stainless steel bar around which a thin wire (ϕ 0.1 mm) is tightly wrapped, and is a tool commonly used for preparing ultra-thin coatings in the thin film industry.

Figure 1 shows polarized optical absorption spectra of a fabricated gelatin-SWNT thin film. We also observed near-infrared fluorescence from the film, which is characteristic of isolated single nanotubes. Polarized absorption spectroscopy demonstrates that SWNTs tend to be oriented in the spreading direction and the fine structures in the absorption spectra indicate that the nanotubes were isolated in the gelatin matrix. This orientation is attributed to a flow-induced shear force between the wire-bar and the substrate. Hence, it is expected that using a wire-bar with a thinner wire will improve the degree of orientation due to a stronger shear force.

In this study we have also found SWNTs can be individually dispersed using only gelatin as a dispersing agent instead of surfactants such as SDS. Fig. 2 shows a near-infrared fluorescence spectra of HiPco SWNTs dispersed (a) using gelatin and (b) using SDS in D₂O. The fluorescence peak positions of the gelatin-HiPco differ considerably (\sim 30 meV) from the SDS case. This shift is assumed to reflect the different environments around the nanotubes.

[1] M.J. O'Connell et al., *Science*, **297** (2002) 593.

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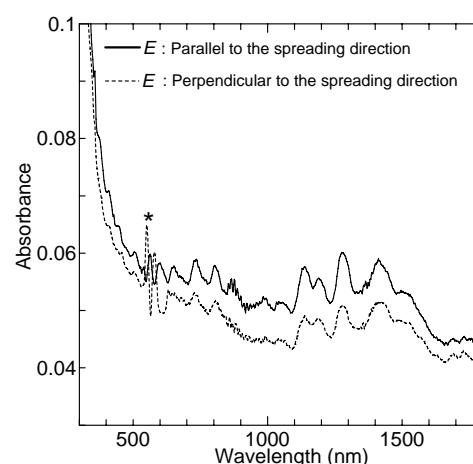


Fig. 1. Polarized optical absorption spectra.

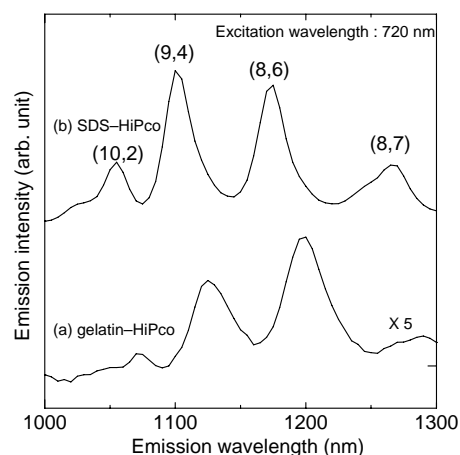


Fig.2. Near-infrared fluorescence spectra