Effect of functionalization and subsequent thermal treatment on photoluminescence properties of single-walled carbon nanotubes

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Single-walled carbon nanotubes (SWNTs), because of their excellent mechanical and electrical properties, have been studied extensively for numerous potential applications. In 2002, near-infrared (NIR) photoluminescence (PL) of semiconducting SWNTs was observed in individually dispersed SWNTs by Weisman et al.[1] Since the structure of SWNTs can be assigned based on its excitation and emission wavelength, NIR PL spectra of SWNTs are used as useful analysis tools in, for example, synthesis and separation of SWNTs. The PL of SWNTs has received significant attention for application in biological imaging because NIR light from 1000 to 1400 nm, which is known as the second NIR window, has high transparency in biological tissues.[2] Recently, considerable effort has been focused on SWNTs functionalization to induce bright red-shifted PL peaks, such as oxidation and arylation reactions using ozone and aryl diazonium compounds, respectively.[3,4] It has been reported that the functionalization degree of SWNTs influence the PL efficiencies emerged after functionalization.

Here we report our recent results on control functionalization degree and NIR PL properties of SWNTs by bulk scale preparation.[5-11] Both steric hindrance of the reagents and subsequent thermal treatment were effective to control functionalization degree of SWNTs and the PL intensities. Additionally, it was revealed that not only the reagents used but also reaction methods influence the amount of Stokes shift observed after the functionalization.

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