Luminescence from Terbium(III) Species upon Sensitization Using Ionic Nanosphere

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Terbium(III) species have been used in a variety of applications, including sensing, photovoltaics, phosphor, display devices, bioimaging and others,[1] owing to their color purity of luminescence whose bands are narrow. In contrast to such applicability, their luminescence is typically weak since both excitation and luminescence processes are Laporte-forbidden. Therefore, a number of terbium(III) systems with strong luminescence have been hitherto developed on the basis of enhancement and acceleration of these processes. In this study, we successfully sensitized the luminescence from terbium(III) species by doping in the ionic nanosphere, which can accommodate various ions in its spherical space with a diameter of <300 nm by the electrostatic interaction,[2] via the energy transfer from the ππ* excited state of the copolymerized styrene–divinylbenzene backbone.

Terbium(III) ion was doped in the nanospheres (5–300 nmol/mg) by soaking the ionic nanosphere in an aqueous solution of $TbCl_3$. In the luminescence spectra of the terbium(III)-ion-doped ionic nanospheres (excitation wavelength: 260 nm, Fig. 1), several luminescence bands were observed at 488, 544, 583 and 620 nm in addition to fluorescence from the ionic nanosphere at around 330 nm. The new bands resemble to the 4f–4f luminescence originating in the $^5D_4 \rightarrow {}^7F_J$ (J = 3–6) transitions in terbium(III) species. It is worth emphasizing that there was no luminescence observed for the aqueous $TbCl_3$ solution with the comparable concentration and that the excitation spectra monitored at 544 nm were similar to the absorption spectrum of the ionic nanosphere. Therefore, the luminescence from terbium(III) species was obtained by the light absorption of the ionic nanosphere, followed by the energy transfer to the terbium(III) ion.

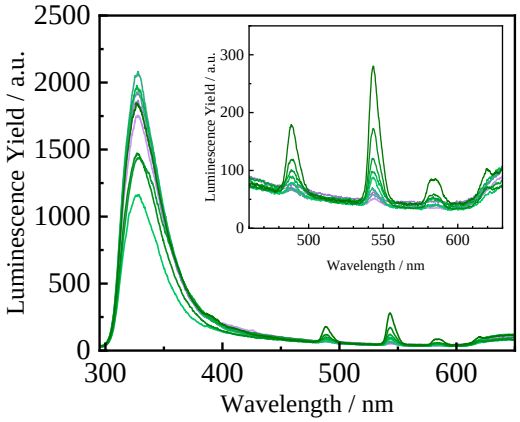

Fig. 1 Luminescence spectra of terbium(III)-ion-doped ionic nanospheres (5–300 nmol/mg, purple → green, λ_{ex} = 260 nm).

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