Effects of Monomer in Ionic Nanospheres on Sensitized Luminescence from Terbium(III) Ion

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Terbium(III) species have been used in a variety of applications, including sensing, photovoltaics, phosphor, bioimaging and others, owing to their high luminescence-color purity arising from narrow band shapes.[1] In contrast to such applicability, their luminescence is typically weak since both excitation and luminescence processes are Laporte-forbidden. An introduction of a photosensitizing unit(s) is one of the most popular strategies to compensate the weak absorption. In this study, we utilized ionic nanospheres, spherical ion-exchange resins with a diameter of <300 nm,[2] as solid-state media and photosensitizers for terbium(III) ion. Luminescence from terbium(III) ion was successfully sensitized upon doping in the ionic nanospheres with and without a ligating unit.

Ionic nanospheres were synthesized by copolymerizing sodium *p*-styrenesulfonate, divinylbenzene and poly(ethylene glycol)methacrylate methyl ether (M_n: 2000) in the absence and presence (1mol%) of 5-(4-vinylphenyl)-1,10-phenanthroline (vPPhen). Terbium(III) ion was doped in the ionic nanospheres (5–300 nmol/mg) by soaking the ionic nanosphere in an aqueous solution of $TbCl_3$. The terbium(III)-doped nanospheres without vPPhen exhibited several luminescence bands at 488, 544, 583 and 620 nm, which resemble to the luminescence originating in the $^5D_4 \rightarrow {}^7F_J$ (J = 3–6) transitions in terbium(III) species, upon an excitation at 260 nm (Figure).[3] In the case of the nanosphere with vPPhen, an excitation at 300 nm resulted in the similar 4f–4f luminescence. Thus, the copolymerized vPPhen would help longer-wavelength excitation as a photosensitizer along with ligating moiety. Detailed effects of the monomer unit on the luminescence from terbium(III) ion will be discussed.

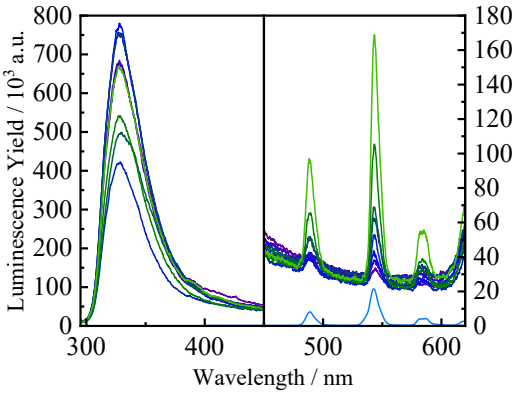

Figure. Luminescence spectra of terbium(III)-doped ionic nanospheres without vPPhen (5.04–299 nmol mg^{-1}, purple → green, λ_{ex} = 260 nm). Blue spectrum represents that of the aqueous $TbCl_3$ solution.

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