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Complex formation of d-metal ions at the interface of Tb III-doped silica nanoparticles as a basis of substrate-responsive TbIII-centered luminescence

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Abstract

The complex formation of d-metal ions at the interface of Tb III-doped silica nanoparticles modified by amino groups is introduced as a route to sensing d-metal ions and some organic molecules. Diverse modes of surface modification (covalent and noncovalent) are used to fix amino groups onto the silica surface. The interfacial binding of d-metal ions and complexes is the reason for the TbIII-centered luminescence quenching. The regularities and mechanisms of quenching are estimated for the series of d-metal ions and their complexes with chelating ligands. The obtained results reveal the interfacial binding of CuII ions as the basis of their quantitative determination in the concentration range 0.1-2.5 μM by means of steady-state and time-resolved fluorescence measurements. The variation of chelating ligands results in a significant effect on the quenching regularities due to diverse binding modes (inner or outer sphere) between amino groups at the interface of nanoparticles and FeIII ions. The applicability of the steady-state and time-resolved fluorescence measurements to sense both Fe III ions and catechols in aqueous solution by means of Tb III-doped silica nanoparticles is also introduced. © 2012 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.

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Keywords

colloids, luminescence, nanoparticles, sensors, transition metals