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Tb(III)-doped silica nanoparticles for sensing: Effect of interfacial interactions on substrate-induced luminescent response

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Abstract

© 2014 American Chemical Society. The present work introduces the easy modification of the water-in-oil microemulsion procedure aimed at the doping of the Tb(III) complexes within core or shell zones of the silica nanoparticles (SNs), which are designated as "core-shell", "shell", and "core". The dye molecules, chelating ligands, and copper ions were applied as the quenchers of Tb(III)-centered luminescence through dynamic or/and static mechanisms. The binding of the quenchers at the silica/water interface results in the quenching of the Tb(III) complexes within SNs, which, in turn, is greatly dependent on the synthetic procedure. The luminescence of "core" SNs remains unchanged under the binding of the quenchers at the silica/water interface. The quenching through dynamic mechanism is more significant for "core-shell" and "shell" than for "core" SNs. Thus, both "core-shell" and "shell" SNs have enough percentage of the Tb(III) complexes located close to the interface for efficient quenching through the energy transfer. The quenching through the ion or ligand exchange is most efficient for "core-shell" SNs due to the greatest percentage of the Tb(III) complexes at the silica/water interface, which correlates with the used synthetic procedure. The highlighted regularities introduce the applicability of "core-shell" SNs used as silica beads for phosphatidylcholine bilayers in sensing their permeability toward the quenching ions.

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