Development of Rh6G thin film as fluorescence sensor for explosive vapor detection

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Abstract

Self-organized rhodamine 6G (Rh6G) thin films on a glass substrate were prepared by spin-coating, dip-coating, and drop-coating. The thickness of the Rh6G layer strongly influences both the absorption and emission spectra, which are accounted for by monomers, exciton and excimer formation, and molecular aggregation. Submonolayer films of Rh6G show one maximum and one apparent shoulder in the absorption spectrum, but three peaks are required for deconvolution of the spectrum. As the thin film becomes thicker, the observed maximum shifts to lower energy, and a fourth peak is required for deconvolution. The emission spectra show similar features. In addition, the relative intensity of the emission is strongly dependent on the film thickness with thinner films being substantially more emissive than thick films. When putting this Rh6G layer on a transparent layer of PMMA polymer, a huge emission enhancement occurs due to internal reflection and increased surface area. The mechanisms underlying TNT detection are collisional quenching and aggregate enhancement corresponding to different Rh6G thickness thin film. The thickness of the Rh6G is a key feature in determining the sensitivity of the sensor. With this new sensing system, selectivity can be improved by using a variety of fluorophores with high quantum yield to create a sensor array.