Humidity-sensitive luminescent dye-doped polyelectrolyte films: Fabrication, characterization, and potential application as colorimetric moisture sensor

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A novel type of luminescent dye-doped polyelectrolyte films, which change their light absorption and photoluminescent properties upon changing relative humidity (RH) is reported. A polyelectrolyte – poly(4-styrene sulfonic acid) (PSSA) was chosen as a matrix, while Coumarin 6 (C6) was used as a luminescent dye. The films were prepared using a dip-coating technique. Coatings with a refractive index (RI) of around 1.49 and various thicknesses in a submicrometric range were obtained by changing the withdrawal speed or concentration of the polyelectrolyte. It was found that depending on the RH, C6 in the polyelectrolyte films may exist in two equilibrium forms – monocationic and dicationic. Significant differences between these two forms upon RH level variations were observed and investigated using FT-IR and UV–Vis spectroscopic techniques. FT-IR spectroscopy confirmed the distortion of the double bond conjugation in the benzothiazole unit of the dicationic form of the dye in the dry state. The dependences of the UV–Vis absorption and luminescent properties on RH were determined. The distinct color changes of the films, ranging from faint yellow to intense pink-red, enabled the estimation of the RH level through visual inspection. Taking advantage of a straightforward preparation protocol for this newly developed material, we believe that it may be used as a humidity-sensitive coating.

Słowa kluczowe

Coumarin 6, Polyelectrolyte, Dip-coating, Luminescent humidity sensor

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