Temperature-responsive hybrid films combining rare-earth phosphors and thermochromic materials for optical sensing

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Conventional temperature sensors typically exhibit significant drawbacks, including low spatial resolution, slow response times, and diminished sensitivity across wide temperature ranges. Addressing these limitations, this study introduces a novel hybrid temperature sensor that integrates organic thermochromic materials with lanthanide-doped luminescent phosphates—a combination not previously reported in the literature. The sensor leverages the reversible color-changing abilities of thermochromic materials along with the temperature-sensitive luminescence of lanthanide nanophosphors comprising Eu^{3+}/Tb^{3+} co-doped $REPO_4$ (RE = Y or Gd). Embedded within a flexible polyvinyl acetate matrix, the resulting device provides a dual sensing mechanism: offering both immediate visual feedback through color change and precise thermal measurements via ratiometric luminescence analysis. This unique interaction facilitates real-time, high-sensitivity temperature monitoring. The results underscore the significant potential of this hybrid system for advanced temperature sensing applications where high spatial resolution and dynamic responsiveness are critical.

Słowa kluczowe

Hybrid temperature sensor, Thermochromic materials, Rare earth elements, Luminescence nanothermometry

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