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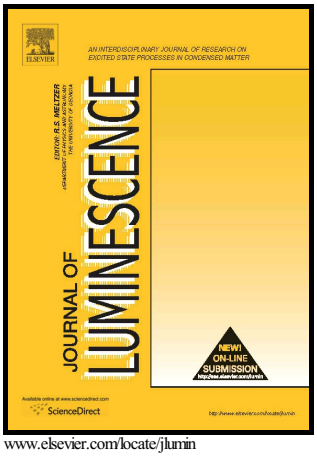

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Abstract

We develop two soluble Sm-doped ternary complexes for use as two-color thermometry (TCT) phosphors. These complexes are $Sm(acac)_3(TOPO)_2$ and $Sm(hfa)_3(TOPO)_2$, which are doped into HTPB polymer and optically characterized as a function of temperature. Both materials are found to have similar TCT calibration curves with an average energy spacing of $\Delta E = 99(\pm 10) \times 10^{-3}$ eV and an intensity ratio proportionality constant of $A = 0.65 \pm 0.16$. We estimate $Sm(acac)_3(TOPO)_2$'s maximum functional temperature for continuous heating to be 497 K, while $Sm(hfa)_3(TOPO)_2$ is limited to 441 K due to irreversible thermal degradation of the complex. These complexes have promise as non-contact molecular temperature sensors in a wide variety of polymers and solvents.

Keywords:

Keywords: Lanthanides, Thermometry, Temperature Sensors, Organic Complexes

1. Introduction

Developing a better understanding of shock induced hot-spot formation in heterogeneous systems is of special importance to the science of plastic bonded explosives (PBXs). PBXs are heterogeneous materials consisting of: a polymeric binder, energetic molecular crystals (MCs), and other additives (plasticizers, antioxidants, taggants/markers, and friction-generating grit). Through the past several decades, research into shock-induced detonation of PBXs has concluded that detonation occurs due to hot-spot formation, which leads to thermal decomposition of the energetic MCs and energy release [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14]. While the mechanisms of hot-spot formation have been studied extensively, it is currently unknown which mechanisms are responsible for thermal decomposition given a specific material composition and loading conditions [12].

To study the effect of composition on hot-spot formation in heterogeneous materials requires simultaneous microstructural imaging and imaging thermometry on the ns-μs time scale with spatial resolution on the

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