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Irreversible phase transitions in doped metal oxides as temperature sensors in explosions[1] HERGEN EILERS, RAY GUNAWIDJAJA, THANDAR MYINT, Washington State University, JAMES LIGHTSTONE, NSWC-Indian Head Division — The temperature of post-detonation fireballs produced by advanced energetic formulations is commonly determined using optical methods such as pyrometry and spectral line fitting. These methods provide an average temperature mostly from the surface of the fireball. However, for many applications the ability to probe the internal temperature and temperature gradients within the fireball is highly desirable. One method that has shown promise is seeding micron to nano-sized temperature sensors into the fireball which can be collected and analyzed post-detonation. In this work, disordered Eu3+-doped nanoparticles were subjected to various heat treatments, incl. furnace, T-Jump, pulsed laser, and explosive heating. This treatment leads to irreversible phase transitions which are monitored by the Eu dopants. Optical signatures such as the ratio of electric and magnetic dipole transition intensities, energy level splitting, FWHM, etc. are evaluated to monitor the phase transitions. Also, the kinetics of particle growth is evaluated as an indicator for the time-dependence of the heating process. The information is used to establish a correlation with the temperature profile. Temperature profiles collected from a series of lab-based tests and small-scale detonations of an aluminized explosive will be presented.

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