EMISSION CHARACTERISTICS OF A DAMAGE SENSOR MATERIAL

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The main impetus for the development and characterization of luminescent materials has been derived from their application to display devices. Another emerging application of these materials is in sensor technology. Recently, triboluminescent materials have been proposed as smart sensors of structural damage [1]. These materials can be embedded in a host structure. When the damage/fracture takes place in the host structure, it will lead to the fracture of triboluminescent crystals resulting in a light emission. This will warn, in real time, that a structural damage has occurred.

The triboluminescent emission of the candidate phosphor has to be sufficiently bright, so that the intensity reaching from the point of fracture to the detector is strong enough to be detected. There are a large number of triboluminescent materials but few satisfy the above criterion. We synthesized europium tetrakis (dibenzoylmethide) triethylammonium (EuD_4TEA) following the procedure of Hurt *et al.*[2]

In an experiment EuD_4TEA was embedded in a transparent epoxy and attached at the bottom of a composite disc facing a digital camera. When the disc was fractured by the impact of a weight from the top, the light emission was observed from the epoxy disc along the line of fracture as shown in fig 1.

The triboluminescent spectrum was recorded by Princeton Optical Multichannel Analyzer (OMA) in the wavelength range 500-800 nm using a silicon diode array cooled to –25 C. The spectrum is shown in fig 2. The photoluminescence under 363 nm excitation from an Ar ion laser is shown in fig 3. The emission is characteristic of Eu^{3+} ion. It exhibits spectral lines due to the transitions from the $^5D_0$ level to some of the levels of ^7F ($^7F_0$, $^7F_1$, $^7F_2$, $^7F_3$ and $^7F_4$) manifold. The dominant transition is $^5D_0 \rightarrow {}^7F_2$. It is this emission which is clearly seen in triboluminescence, however, it appears to be slightly shifted towards longer wavelengths. There are some minor variations between the triboluminescence and photoluminescence spectra, which will be discussed. The effect of temperature and other parameters on photo/tribo luminescence spectra will also be presented.

[1] I. Sage *et al.* Smart Mater. Struct. **8,** 504-10 1999

[2] C.R. Hurt *et al.* Nature, **212,** 179-180, 1966

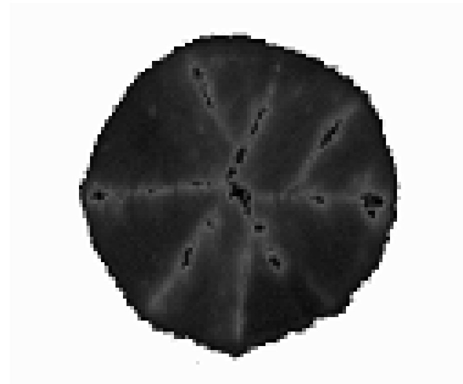

Fig. 1 Triboluminescence of EuD_4TEA embedded in epoxy resin

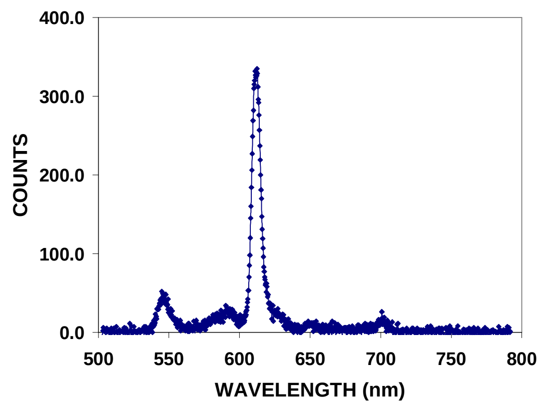

Fig. 2 Triboluminescence spectrum of EuD_4TEA

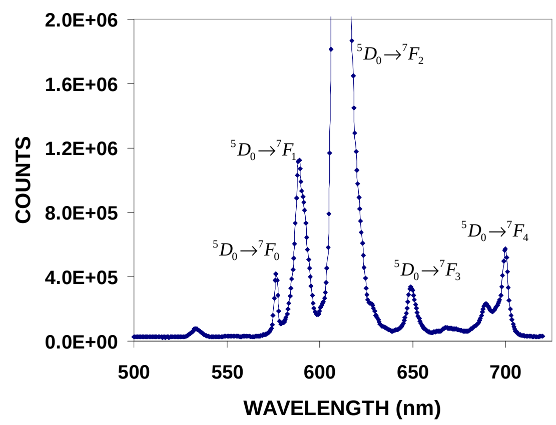

Fig. 3 UV laser-excited luminescence spectrum of EuD_4TEA