Trans-Stilbene Photoluminescence and Scintillation Property Evolution with Temperature

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Trans-stilbene is well recognized, as an organic scintillator, for its high light yield and excellent pulse shape discrimination properties [1] that render it one of the most interesting materials for the simultaneous detection of fast neutrons and gamma photons in mixed radiation fields. As with many organic compounds, trans-stilbene suffers of inherent large self-absorption phenomena of the scintillation light that could impact the scintillation characteristics of this material. In this contribution, we will present and discuss temperature resolved steady state and time resolved photo- and radioluminescence results obtained on two different crystals obtained using two growth methods (from the melt and from solution), with the main aim of improving our current understanding of the functional properties of trans-stilbene.

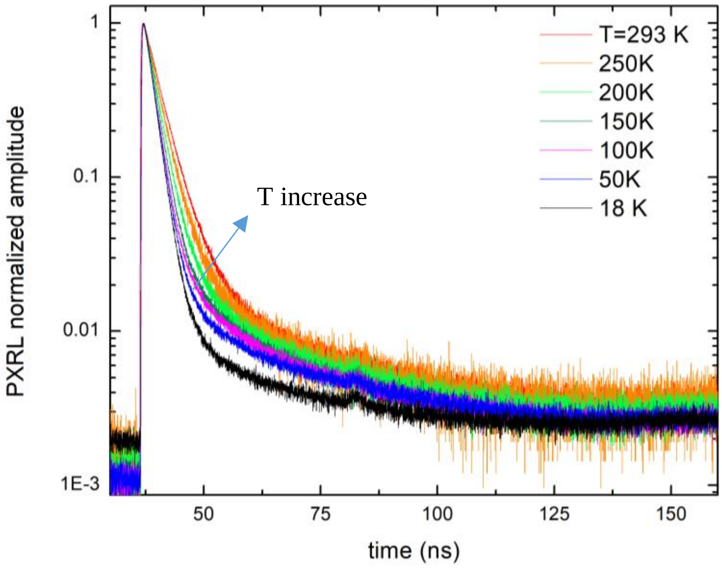

Figure 1: pulsed x-ray decays as a function of the measurement temperature obtained on a trans-stilbene grown from solution.

Temperature resolved scintillation decay measurements (figure 1) reveal a substantial and unexpected increase (from <2 ns to ~3 ns) in the primary decay time by increasing the temperature from 20 K to 290K. The main decay is accompanied by a longer non-exponential component, whose relative weight is also somewhat influenced by the temperature particularly below 100 K, and that is very likely related to triplet-triplet annihilation phenomena.

Steady state photoluminescence measurements as a function of the temperature show significant changes in the emission spectra as a function of the temperature, with the substantial reduction in intensity of two short wavelength components of the emission itself as the temperature is increased.

These modifications can be related to the increase in self-absorption and to an increase in probability of radiation trapping phenomena occurring in the crystal.

1. LM Bollinger and GE Thomas, “Measurement of the time dependence of scintillation intensity by a delayed coincidence method” *Rev. Sci. Instrum.* **32**, 1044 (1961).

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