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Escape from the trap: trapping and detrapping in persistent phosphors

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Persistent or afterglow phosphors are luminescent materials having the ability to emit light long after they have been excited [1]. Although temperature is clearly a driving force in the release of trapped charge carriers, many questions still surround the trapping and detrapping processes [2, 3]. In this contribution we start from key experimental observations on the trapping process, including the influence of the excitation wavelength and temperature, in a range of host materials, such as oxides [4], oxynitrides and nitrides [5]. The role of valence state changes in $SrAl_2O_4$:Eu,Dy are discussed, based on time-dependent, optically pumped x-ray absorption measurements [6].

In a second part, we focus on aspects of the detrapping. The standard conditions of constant temperature – when collecting afterglow curves – are hardly ever met in outdoor applications. The influence of varying temperature in trapping and detrapping regimes is discussed. The feasibility of the recently proposed application of glow-in-the-dark road marks is critically assessed [7]. Alternative detrapping mechanisms, such as optical stimulation, the application of stress [8], mechanical pressure or ultrasound, are considered in detail for the bluish-green emitting $BaSi_2O_2N_2$:Eu phosphor [9].

Finally, a numerical approach is presented to describe the dynamics in the trapping and detrapping processes, simultaneously focussing on charging, afterglow and thermoluminescence intensity profiles [10].

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