Persistent luminescence in rare-earth doped nitrido-silicates

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The majority of persistent phosphors known today are based on aluminates or silicates and emit in the blue or green region of the visible spectrum [1]. Orange or red phosphors, strongly desired for emergency signage and medical imaging, are scarce. We prepared the yellowish-orange nitrido-silicates $M_2Si_5N_8$:Eu,R (M = Ca, Sr, Ba), and their rare-earth codoped variants (R = Nd, Dy, Sm, Tm) through a solid state reaction, and investigated their luminescence and afterglow properties [2]. Additionaly, we investigated how the material behaves when exposed to water, air or heat for extended periods of time, and compared this to several commercially available phosphors.

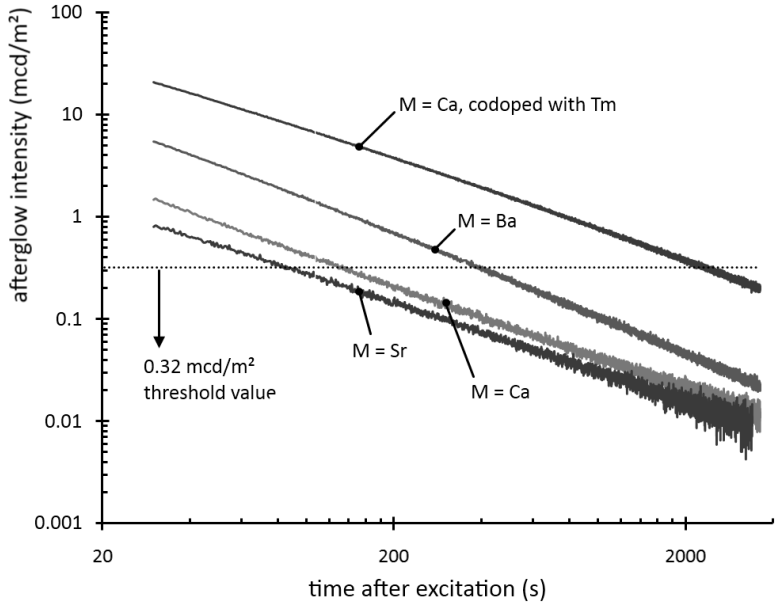

Figure 1: Decay of the afterglow intensity after 1 min excitation with a Xe arc lamp at 1000 lux.

Persistent luminescence is present in all the prepared samples, but the brightness and duration of the afterglow strongly depends on the host material, the codopant and the choice and ratio of the starting products. This demonstrates the importance of charge carrier traps that are suitably located (both physically and energetically), since these govern the maximum light storage and release capabilities of a persistent phosphor. The number and depth of these traps are estimated from the thermoluminescent glow curve, the integrated light output and the decay profile. Of all the prepared materials, $Ca_2Si_5N_8$:Eu,Tm is the most promising persistent phosphor with a bright orange afterglow that remains visible for about an hour.

[1] K. Van den Eeckhout, P.F. Smet, D. Poelman, *Materials* **3** (2010) 2536-2566.
[2] K. Van den Eeckhout, P.F. Smet, D. Poelman, *Materials* **4** (2011) 980-990.