Glow-in-the-dark traffic markings: feasible or not?

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Nowadays persistent luminescent materials are already used in lots of applications ranging from commercial glow-in-the-dark applications such as watch dials, pictograms for emergency exit signs, luminous paints, toys and gadgets,… to more advanced applications such as *in vivo* biomedical imaging [1,2]. Numerous publications also mention glow-in-the-dark traffic markings as a possible application for persistent luminescent phosphors. The underlying idea is noble, as electrical street lighting is energy consuming (According to the Energy research Centre of the Netherlands (ECN) electrical street lighting is responsible for 1.5% of the total electricity consumption in the Netherlands [3]) and passive alternatives could decrease our global ecological footprint. However, the properties of the nowadays existing persistent luminescent phosphors are tuned towards optimal efficiency for indoor applications such as emergency exit signs. The performance of persistent luminescent materials strongly depends on the ambient conditions such as daytime light levels, temperature variations, ambient light levels during the night,… these are parameters that can differ a lot when comparing outdoor and indoor conditions.

To investigate the behavior of europium and dysprosium co-doped strontium aluminates ($SrAl_2O_4$:Eu,Dy) under variable ambient conditions, measurements were conducted in an especially designed setup in which a temperature profile and illuminance profile could be programmed to simulate a real day and night, using data from a weather station. The setup and used weather station data will be explained. The results of measurements of two different days/nights, being a cold clear winter day and a warm cloudy summer day, will be shown and discussed.

The conclusions drawn are that glow-in-the-dark road markings could be a promising alternative for energy wasting electrical street lighting. However, the current persistent luminescent materials such as $SrAl_2O_4$:Eu,Dy are not good enough to cope with the variable conditions during nighttime over different seasons. Neither they are efficient enough to assure the same level of safety as electrical street lighting.

[1] Van den Eeckhout, K.; Smet, P.F.; Poelman, D. “Persistent Luminescence in Eu^{2+}-Doped Compounds: A Review”. Materials 2010, 3, 2536-2566.

[2] Maldiney, T.; Sraiki, G.; Viana, B.; Gourier, D.; Richard, C.; Scherman, D.; Bessodes, M.; Van den Eeckhout, K.; Poelman, D.; Smet, P. F. "In vivo optical imaging with rare earth doped $Ca_2Si_5N_8$ persistent luminescence nanoparticles," Opt. Mater. Express 2012, 2, 261-268

[3] Bremmers, P.; Veltman, A.T.; Fernhout J.T. “Energieverbruik in openbare verlichting en verkeersregelinstalaties: Eindrapport openbare verlichting”. “http://www.ecn.nl/docs/library/report/2000/c00095.pdf” (May 21 2013)