Efficient white persistent luminescence materials based on mineral-inspired Ti-doped hackmanite structures

J.M. Carvalho[1,*], I. Norrbo[2], H.F. Brito[3], M. Lastusaari[2,4]

[1] Universidade de São Paulo, Instituto de Física, Dept. Física Aplicada, São Paulo, SP, Brazil. [2] University of Turku, Department of Chemistry, Turku, Finland. [3]Universidade de São Paulo, Instituto de Química, SP, Brazil [4]Turku University Centre for Materials ad Surfaces, Turku, Finland.
** Corresponding author: jmc@if.usp.br*

Persistent luminescence (PeL) materials are used in everyday glow-in-the-dark applications and they show high potential for, e.g., medical imaging[1], night-vision surveillance, and enhancement of solar cells. However, the best performing materials contain rare earths and/or other heavy metal and expensive elements such as Ga and Ge, increasing the production costs. Here, $(Li,Na)_8Al_6Si_6O_{24}(Cl,S)_2$:Ti, a heavy-metal- and rare-earth-free low cost material is presented. The mineral inspired structure is versatile and can be tailored to change the properties based on the structure. It can give white PeL that stays 7 h above the 0.3 mcd.m^{-2} limit and is observable for more than 100 h with a spectrometer (Fig. left). This is a record-long duration for white PeL and visible PeL without rare earths. The material has great potential to be applied in white light emitting devices (LEDs) combined with self-sustained night vision using only a single phosphor (Fig. right). The material also exhibits PeL in aqueous suspensions and is capable of showing easily detectable photoluminescence even in nanomolar concentrations, indicating potential for use as a diagnostic marker. Because it is excitable with sunlight, this material is expected to additionally be well-suited for outdoor applications.

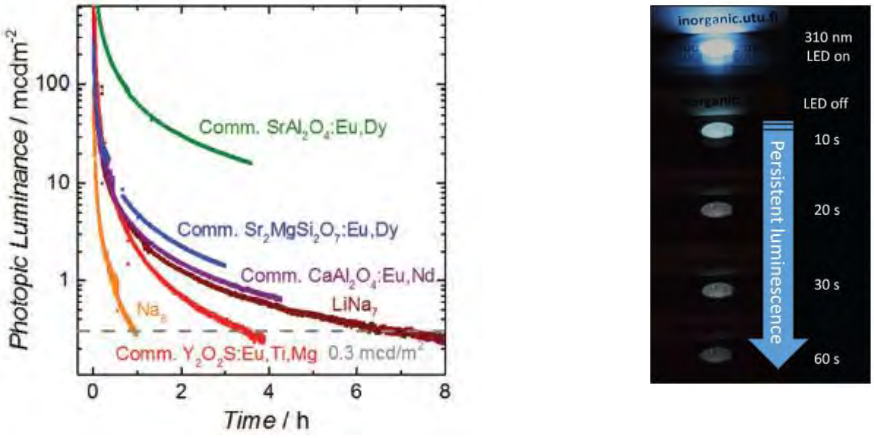

Figure: Photopic luminance of the commercial persistent luminescence materials and hackmanite with Na8 and LiNa7 structure (Left). Phosphor performance with 310 nm LED excitation and subsequent persistente luminescence (Right).

Keywords:Persistent Luminescence, White LED, Hackmanite, Titanium.

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References

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