Pushing the limits of persistent phosphors

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Persistent phosphors are a specific and fascinating type of luminescent materials, which can emit light long after the excitation ended, which is realized by temporarily storing energy in the crystal lattice [1,2]. Ambient heat can release the trapped charge carriers, after which recombination and light emission can occur. Several materials are known to emit light for tens of hours after the end of the excitation, not only in the visible part of the electromagnetic spectrum, but also in the infrared, opening novel applications in the field of bio imaging. For many applications, such as in emergency signage, the storage capacity of persistent phosphors should further be increased, which would even open new application areas, such as glowing road marks [3].

For developing better materials in a deliberate way, it is important to know the key parameters determining the trapping capacity of persistent phosphors [4]. Hence we start from a quantification of the number of trapped charges in fully charged phosphors [5] and couple this to the trapping and detrapping processes [6]. An important loss mechanism is an optically stimulated release of previously trapped charges and subsequent luminescence (OSL) [7]. Finally, we explore novel application areas of specific persistent phosphors which can also release previously trapped charges upon application of pressure, in a process called mechanoluminescence (ML) [8]. These materials, such as $SrAl_2O_4$:Eu, CaZnOS:Mn and $BaSi_2O_2N_2$:Eu, cannot only be used to visualize stress distributions, they also allow the full 3D reconstruction of ultrasound pressure fields [9]. Smart trapping and detrapping approaches give further functionality to ML phosphors.

References

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