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Synthesis and characterization of blue persistent luminescent glass composite

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Materials with Persistent Luminescence (PeL) store energy in its bandgap electron traps and release them through a mechanism ruled by a thermal equilibrium (k_BT). The solid-state synthesis of efficient PeLs as $Sr_2MgSi_2O_7$:Eu^{2+}, Dy^{3+}, $SrAl_2O_4$: Eu^{2+}, Dy^{3+} and $CaAl_2O_4$: Eu^{2+}, Dy^{3+} generally require high temperatures and long thermal treatments. Flux agents such as H_3BO_3 are known to facilitate sintering and promoting persistent phase formation, yet, without full effectiveness in lower temperature. The second barrier relies on *in-situ* reduction and stabilization of Eu^{3+} to Eu^{2+}. Alternatively, glass-controlled crystallization is suited for obtaining a bulk shape PeL material embedded into a protective glass matrix. However, as silicate and aluminossilicate matrixes require much higher temperatures to melt, this method can make synthesis less practiced. Therefore, this study aims to explore lower temperature with shorter melting time of blue emitter $Sr_2MgSi_2O_7$:Eu^{2+}, Dy^{3+} in one single step to an optimized high mass batch PeL synthesis. Here, the precursors were weighed and mixed in a planetary mixer aided by ethanol. The solution was dried overnight and heat treated from ambient temperature to 1050 ºC to eliminate CO_2 and H_2O. The appropriate amount of NH_4Cl and H_3BO_3 were mixed with the precursors in the process. The solution was dried and heat treated at 1100 ºC for 1 h in a covered crucible. XRD patterns and Raman spectra confirm the obtention of melilite phase when using NH_4Cl and H_3BO_3 as flux. SEM-EDS elemental mapping suggests crystal growth from a different phase containing chloride ions. The next step is improving the sample thermal stability (ΔT) to form a bulk glass and crystallize nanoparticles of SMSO producing a glass-ceramic composite.

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References

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