

Charge compensation in RE^{3+} (RE=Eu, Gd) and M^+ (M=Li, Na, K) co-doped alkaline earth nanofluorides obtained by microwave reaction with reactive ionic liquids leading to improved optical properties.

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Streszczenie

Alkaline earth fluorides are extraordinarily promising host matrices for phosphor materials with regard to rare earth doping. In particular, quantum cutting materials, which might considerably enhance the efficiency of mercury-free fluorescent lamps or SC solar cells, are often based on rare earth containing crystalline fluorides such as NaGdF_4 , GdF_3 or LaF_3 . Substituting most of the precious rare earth ions and simultaneously retaining the efficiency of the phosphor is a major goal. Alkaline earth fluoride nanoparticles doped with trivalent lanthanide ions (which are required for the quantum cutting phenomenon) were prepared *via* a microwave assisted method in ionic liquids. As doping trivalent ions into a host with divalent cations requires charge compensation, this effect was thoroughly studied by powder X-ray and electron diffraction, luminescence spectroscopy and ^{23}Na , ^{139}La and ^{19}F solid state NMR spectroscopy. Monovalent alkali ions were codoped with the trivalent lanthanide ions to relieve stress and achieve a better crystallinity and higher quantum cutting abilities of the prepared material. ^{19}F -magic angle spinning (MAS)-NMR-spectra, assisted by $^{19}\text{F}\{^{23}\text{Na}\}$ rotational echo double resonance (REDOR) studies, reveal distinct local fluoride environments, the populations of which are discussed in relation to spatial distribution and clustering models. In the co-doped samples, fluoride species having both Na^+ and La^{3+} ions within their coordination sphere can be identified and quantified. This interplay of mono- and trivalent ions in the CaF_2 lattice appears to be an efficient charge compensation mechanism that allows for improved performance characteristics of such co-doped phosphor materials.

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