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Abstract
Perfectly transparent ceramics of $La_{0.4}Gd_{1.6}Zr_2O_7$ doped with either Eu^{3+} or Pr^{3+} ions were prepared by high-temperature vacuum sintering. Results of the Rietveld structure refinement and spectroscopic properties of the ceramics are presented and discussed in details. Photoluminescence characteristics support the non-uniformity in the crystal structure of ceramics. X-ray excited luminescence of $La_{0.4}Gd_{1.6}Zr_2O_7$:Eu was rather inefficient and the Pr-doped ceramics showed no Pr-related radioluminescence. Instead they produced Eu^{3+} emission characteristic for Gd_2O_3:Eu phase not detected in X-ray diffraction patterns.

1. Introduction

Compounds of the general formula $A_2B_2O_7$ (A and B stands for 3+ and 4+ ions, respectively) are hosts for materials with a whole variety of actual and potential applications. Examples are thermal barrier coatings [1],[2],[3],[4],[5],[6], nuclear waste forms [7],[8],[9],[10],[11],[12],[13], electrolytes [14],[15], catalysts [16] and optical materials [17],[18],[19],[20],[21],[22],[23]. The $A_2B_2O_7$ compounds can crystallize in either ordered pyrochlore or disordered fluorite structures. The pyrochlore phase is considered as a superstructure of the fluorite phase with doubled *a* axis. The ratio of ionic radii of cations at A and B sites affects directly the crystal phase they form which in turn influences the compositions spectroscopic properties. What complicates the effect of the structure on the compositions properties is their tendency towards formation of anionic Frenkel defects [24],[25],[26],[27]. Their population quickly increases if processing is performed at high temperatures [28],[29] which is the case of transparent ceramics fabrication.

In the case of rare earth zirconates, $RE_2Zr_2O_7$, the stable pyrochlore structure is formed when r_{RE}/r_{Zr} ratio ranges from 1.26 Å (for CN_{Zr} = 8) or 1.48 Å (for CN_{Zr} = 6) up to 1.78 and depends directly on the RE^{3+} ionic radius. Below the correspondingly lower limit values the pyrochlore structure becomes disordered and transfers to a defect-fluorite structure [30],[31]. When the r_{RE}/r_{Zr}>1.78, a monoclinic/δ (delta) phase is formed [32]. Furthermore, pyrochlore