INFLUENCE OF TITANIUM DOPING ON THE STRUCTURAL PROPERTIES OF YAG:Pr

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Yttrium aluminium garnet (YAG) is one of the most widely used host materials for rare-earth ions due to its excellent thermal and chemical stability, as well as its beneficial optical properties, such as optical transparency over a broad UV–IR wavelength range [1,2]. The emissions of YAG:Pr arise from 4f–4f and 4f–5d electronic transitions (photoluminescence at UV and red-light wavelengths), making it suitable for lighting, scintillation, and potential laser technologies [3]. Consequently, YAG:Pr has been extensively researched. However, there haven't been many studies on co-doping YAG with praseodymium and transition metals, particularly with titanium. Titanium can substitute for aluminium in various structures and considering the success of titanium–doped sapphire uses in laser technologies, it is intriguing to study how this element can affect the structural properties of YAG:Pr [4]. Additionally, titanium can exist in two oxidation states: +4 and +3, which should influence how well it can be incorporated into garnet, as it replaces of Al^{3+} ions. The effects of this should be most visible in calcined samples, as during the calcination of YAG structures, many oxygen vacancies are filled [5]. Moreover, titanium compounds have shown great antibacterial activity [6]. And considering that YAG:Pr emits UV radiation after excitation, it is interesting to see how strong antibacterial properties YAG structures co-doped with praseodymium and titanium may exhibit [7].

In this work, yttrium aluminium garnets, doped with different amounts of Pr^{3+} and Ti^{4+} ions, have been synthesized by the aqueous sol-gel method and the effects of titanium doping in YAG:Pr have been examined. Phase composition was determined by X-ray diffraction analysis, which showed how a new phase appears at higher (≥10 %) titanium concentrations. Sample morphology was examined using scanning electron microscopy, and it was observed how different amounts of titanium change the morphology. In addition, the photoluminescence behaviour of the materials and the effect of titanium and praseodymium were studied.

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