Persistent luminescence effect and the MMCT mechanism in terbium- and praseodymium-doped perovskites

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Perovskites are a class of emerging materials widely studied due to their structural malleability, allowing them to accommodate many different ions in their structure without generating significant distortions in their crystal lattice. This versatility gives these materials unique optical, magnetic, and electrical properties when associated with other elements [1]. Based on this principle, Calcium titanate (CaTiO3) and sodium niobate (NaNbO3) perovskites were synthesized through microwave-assisted solid-state synthesis (MASS), a quick and easy technique when compared to other methods [1]. Despite these materials belonging to the same class and having very similar chemical characteristics, the results showed significant differences during the synthesis process. X-ray diffraction analyses showed that for CaTIO3, both time and power are decisive to produce the pure material, reaching purity at 700 Watts in 15 minutes, while for NaNbO3, the synthesis time has more to say about the formation of theier structure since with only 500 watts 15 minutes the pure material was already obtained. The diffuse reflectance analysis (DRS) also revealed that the bands MMCT and 4f-4f of praseodimium ion were more evident for NaNbO3 than CaTiO3, showing the greater sensitivity of the matrix with the insertion of the dopant [2]. In terms of persistent luminescence, both materials presented the same persistence time (around 120 seconds) when doped with praseodymium; however, in terms of dopant concentration, the longest persistence time was obtained at concentrations of 0.01 mol% for CaTiO3 and 0.1 mol% for NaNbO3. The 10-fold difference in dopant concentration shows that the unique structural characteristics and how the dopant is accommodated in the material determine how many defects it can accommodate. No persistent luminescence effect was observed for both matrices when doped with terbium,which may show a relationship between the energy levels of the dopant ions and the MMCT state [3].

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