

# Effect of Doping Rare-earth Elements on the Structural and Dielectric Properties of $Sr_2RETi_2Nb_3O_{15}$ Compounds (RE = Gd, Sm, Nd)

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## Abstract

Tungsten bronze tetragonal (TTBs) materials have showed a particular attractive properties, especially in the electronic field (electrical, magnetic, etc) and for their catalytic behavior. The TTBs are widely studied in various application areas as ferroelectric materials, semiconductors, energy storage and photo-degradation catalytic applications. In this work, the impact of rare-earth substitution on the structural and dielectric properties of  $Sr_2RETi_2Nb_3O_{15}$  (RE = Gd, Sm, Nd) materials was investigated. The synthesis was carried out by solid-state reaction methods, and the proposed structure of the samples and their electrical properties were confirmed and investigated using the X-ray diffraction (XRD) and complex impedance spectroscopy (CIS) techniques, respectively. The results showed that the rare-earth substitution affects the crystal structure, where the transition from space group  $P4bm$  (for Sm and Nd) to  $P4/mbm$  (for Gd) was recorded, which attributed to the effect of the gap between ionic radius. Furthermore, the CIS results showed a drastic effect of the substitution reaction on the dielectric constants and losses. On the other hand, the electrical results showed a ferroelectric behavior for the Sm and Nd, however the Gd exhibited a paraelectric behavior. The findings, in this paper, suggest a potential enhancement in dielectric performance, making these materials promising candidates for applications in electronic devices and high-performance capacitors.

## Keywords

Materials, Ferroelectric, Rare-earth, X-Ray Diffraction (XRD), Complex Impedance Spectroscopy (CIS)