Investigations on structural, morphological, and optical properties of $La_{0.75}Ba_{0.25-x}Sr_xFeO_3$ (x = 0.0 and 0.1) nanoparticles and their gas-sensing performances

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The Auto-combustion method has been adopted to synthesize the $La_{0.75}Ba_{0.25-x}Sr_xFeO_3$ (x = 0.0 and 0.1) multiferroic compounds to study the Strontium insertion effect on structural ana gas sensing properties. The orthorhombic crystallinity with a Pnma space group was demonstrated for both compounds by the Rietveld analysis of the X-Ray diffraction patterns. The insertion of 10% of Sr^{2+} ions in A-site induces a distortion in the FeO6 octahedron of the perovskite materials. Meanwhile, the Raman spectroscopy confirms well the distortion of FeO_6 octahedron due to the strontium insertion. The band gap energy slightly increases from 2.432 to 2.462 eV with Sr^{2+} ion insertion, which confirm their utility for photocatalytic applications. The Havriliak-Negami formalism, used to adjust the imaginary part of dielectric Modulus, confirmed a non-Debye dielectric process. The conduction mechanism is ascribed to the non-Overlapping Small Polaron hopping between iron-states.

Importantly, the $La_{0.75}Ba_{0.15}Sr_{0.1}FeO_3$ compound shows higher response values towards acetone and ethanol gases even at low gas concentrations (5 ppm). Response and recovery times have been calculated and found to be less than 40 and 20 seconds, respectively.

Acknowledgement: *This work was supported by National Grants no. UIDB/04564/2020 and UIDB/00313/2020. It was also supported by QREN-Mais Centro Project No. ICT_2009_02_012_1890*