

SOL-GEL SYNTHESIS AND CHARACTERIZATION OF $\text{Nd}_{1-x}\text{Na}_x\text{MnO}_3$ PEROVSKITES

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Rare-earth manganite perovskites with the general formula RMnO_3 (R = rare-earth element) represent a prominent class of strongly correlated oxides, in which charge, spin, orbital, and lattice degrees of freedom are strongly coupled, leading to rich magnetic and structural behavior [1]. These compounds crystallize in the ABO_3 perovskite structure, where distortions of the MnO_6 octahedra, governed by the A-site ionic radius and tolerance factor, play a decisive role in determining their structural stability and physical properties [1].

Rare-earth manganites have also attracted significant attention in the field of multiferroics and magnetoelectrics, as structural distortions and spin–lattice interactions in perovskite oxides can give rise to coupled magnetic and electric phenomena [2,3]. Among this family, NdMnO_3 is of particular interest due to the coexistence and interaction of Mn and Nd magnetic sublattices, which results in complex magnetic behavior and a high sensitivity to structural modifications [4].

A-site substitution offers an effective route for tuning the structure and properties of NdMnO_3 -based perovskites. Partial replacement of Nd^{3+} by monovalent Na^+ alters the charge balance and the $\text{Mn}^{3+}/\text{Mn}^{4+}$ ratio, leading to modifications of the magnetic structure and phase stability, as previously reported for $\text{Nd}_{1-x}\text{Na}_x\text{MnO}_3$ compounds [5]. However, most studies on $\text{Nd}_{1-x}\text{Na}_x\text{MnO}_3$ systems have primarily focused on low Na substitution levels, while investigations covering a wider range of Na concentrations remain limited.

In this work, a series of $\text{Nd}_{1-x}\text{Na}_x\text{MnO}_3$ ($x = 0-0.6$) perovskite oxides were synthesized using the sol–gel method with ethylene glycol as a complexing agent to ensure homogeneous cation distribution. Phase formation and crystal structure were investigated by X-ray diffraction (XRD). Fourier-transform infrared (FT-IR) spectroscopy was employed to confirm the formation of the perovskite framework and to probe changes in metal–oxygen bonding associated with Na substitution. Microstructural features were examined by scanning electron microscopy (SEM), while elemental composition and chemical homogeneity were verified using SEM–EDX and ICP–OES techniques. The results confirm the successful synthesis of Na-doped NdMnO_3 perovskites and provide insight into the influence of A-site substitution on their structural and compositional characteristics.

Keywords: Perovskites, sol-gel, manganites, multiferroics

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