

Structural, Vibrational, Magnetic, and Electronic Properties of La_2MMnO_6 Double Perovskites with $\text{M} = \text{Ni, Co, and Zn}$

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Abstract : This study delves into the structural, vibrational, magnetic, and electronic properties of La_2MMnO_6 double perovskites, where M denotes Ni, Co, and Zn. Recognized for their versatile ionic configurations within the A and B sublattices, double perovskite oxides have attracted considerable interest due to their extensive array of physical properties, which include multiferroic behavior, colossal magnetoresistance, and ferroelectric/piezoelectric functionalities. These materials are pivotal for energy-related technologies like solid oxide fuel cells and water-splitting catalysis, attributed to their superior oxygen ion transport and storage capabilities. This research places particular emphasis on $\text{La}_2\text{NiMnO}_6$ and $\text{La}_2\text{CoMnO}_6$, known for their distinct magnetic, electric, and multiferroic properties, and extends the investigation to $\text{La}_2\text{ZnMnO}_6$, synthesized via high-temperature solid-state chemistry. This addition aims to ascertain the impact of zinc substitution on these properties. Structural analysis through X-ray diffraction has confirmed a monoclinic structure within the $\text{P2}_1/\text{n}$ space group. Comprehensive vibrational studies utilizing infrared and Raman spectroscopy, alongside additional XRD assessments, provide a detailed examination of the dynamic and electronic behaviors of these compounds. The results underscore the significant role of chemical composition in modulating their functional properties. Comparatively, this study highlights that zinc substitution notably alters the electronic and magnetic responses, which could enhance the applicability of these materials in advanced energy technologies. This expanded analysis not only reinforces our understanding of La_2MMnO_6 's physical characteristics but also highlights its potential applications in the next generation of energy solutions.

Keywords : double perovskites, structural analysis, vibrational spectroscopy, magnetic properties, electronic properties, high-temperature solid-state chemistry, La_2MMnO_6 , monoclinic structure, x-ray diffraction

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