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Design and Performance Enhancement of $SrSnO_3$ and $BaSnO_3$ Gas Sensors Using Novel Doping and Synthesis Strategies

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Abstract: *This paper explores the advanced applications of $SrSnO_3$ and $BaSnO_3$ materials in gas sensor technologies, emphasizing their critical role in addressing modern industrial and environmental challenges. The high sensitivity, selectivity, and stability of these perovskite oxides have earned them a reputation for their capacity to detect dangerous gases such as nitrogen oxides, carbon monoxide, and hydrogen. The purpose of this work is to investigate the many ways in which the structural, electrical, and gas-sensing characteristics of these materials are affected by the doping of rare earth elements and metal oxides. Doping tactics are highlighted as a means to induce oxygen vacancies and boost charge carrier mobility, which ultimately leads to enhanced sensor performance.*

In addition, the study investigates a number of different synthesis methods, including as sol-gel, co-precipitation, and solid-state processes, and evaluates the influence that these methods have on morphology, phase purity, and scalability. The association between the structure of the material and the gas-sensing efficiency is examined using advanced characterization methods such as X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The flexibility of SrSnO3 and BaSnO3 sensors is demonstrated by an in-depth analysis of their applications in important fields such as industrial safety, vehicle emission control, and environmental monitoring.

Emerging developments, such as nano-structuring and hybrid material designs, are also investigated, with the goal of showcasing the potential of these innovative approaches to revolutionize sensor technology. At the end of the publication, a demand is made for more research to be conducted on cost-effective synthesis techniques, long-term stability studies, and integration with smart systems in order to improve the performance and usability of these materials. The purpose of this in-depth analysis is to offer a valuable basis for the advancement of gas sensor technologies based on SrSnO3 and BaSnO3, which will address both the present and future sensing demands.

Keywords: $SrSnO_3$, $BaSnO_3$, gas sensors, doping strategies, synthesis techniques, environmental monitoring