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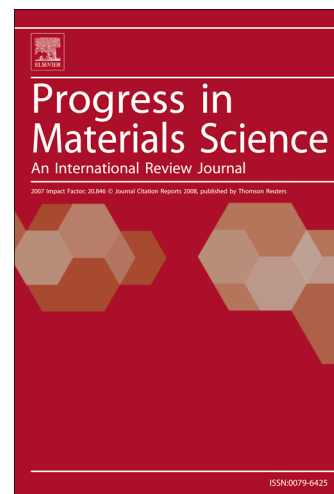
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Recent Development in Lead-Free Perovskite Piezoelectric Bulk Materials

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Abstract: The elimination of lead in piezoelectric applications remains challenging. Since the advances in the piezoelectricity were found in the perovskite family in 2000, studies into lead-free piezoelectric materials have grown exponentially in the fields of condensed matter physics and materials science. In this Review, we highlighted the compelling physical properties of lead-free piezoelectric perovskite materials and summarized their state-of-the-art progress, with an emphasis on recent advances in the piezoelectric effect. We mainly introduced the unique advances in lead-free perovskites piezoelectric bulk materials, along with the descriptions of phase boundaries, domain configurations, and piezoelectric effects, and then the main physical mechanisms of high piezoelectricity were summarized. In particular, the applications of lead-free materials were also introduced and evaluated. Finally, challenge and perspective are featured on the basis of their current developments. This Review provides an overview of the development of lead-free piezoelectric perovskite materials in the past fifteen years along with future prospects, which may inspire material design toward practical applications based on their unique properties.

Keywords: Lead-free materials; Recent advances; Piezoelectric effect; Phase structure; Domain configuration; Physical mechanism; Application.

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