

New Electroceramics Realised through Processing

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Abstract

In terms of chemical composition, the number of new materials is limited. However, by developing our knowledge and skills as they relate to materials processing we are able to generate new products continuously. This paper aims to review several exciting, on-going research activities that have the potential to result in new high-performance electroceramic materials and devices. The activities include innovations in the powder synthesis of complex compositions, single crystals and grain-oriented ceramic ferroelectrics and integrated ferroelectric structures. Powder synthesis is a key issue in high-performance ceramics. Solution processing has the potential to produce chemically homogeneous nanosized particles. Recently, however, similar results were obtained by using mechanically assisted solid-state synthesis. Furthermore, careful control of the suspensions constituent oxides during mixing and/or milling followed by solid-state synthesis yields a highly homogeneous multicomponent oxide powder. The application of these novel methods to the synthesis of complex perovskites and lead-free piezoelectrics is discussed. The excellent performance of single-crystal lead-based relaxors has encouraged research in the processing of grain-oriented ceramics. Here, not only grain-oriented ferroelectric ceramics, but also single crystals can be prepared in a pure ceramic procedure utilizing exaggerated grain growth. Finally, issues related to the integration of different ceramic materials will be addressed. For example, constrained sintering and chemical reactions at the interfaces may cause severe problems. The successful solutions to these problems of ferroelectric thick films on various substrates have led to new devices like integrated ultrasound transducers, bending actuators and LTCC structures.