

Low temperature sintering of PZT ceramics without additives via an ordinal ceramic route

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Abstract

Low temperature sintering of PZT ceramics has been required for co-firing with electrode metals having low melting points. In addition, it is desired for suppression of energy consumption accompanied by high temperature sintering and environmental pollution caused by due to volatilization of lead oxides. Hitherto, it has been reported that fine powders obtained via chemical routes such as a sol-gel process reveal good sinterability. They are, however, expensive and unsuitable for mass-production due to the complicated processes required for the chemical processes. This paper describes low temperature sintering of PZT ceramics without additives using a fine powder obtained by the ordinal ball milling process. The starting powder is the commercial PZT ceramic powder with the composition of $\text{Pb}(\text{Zr}_{0.52}\text{Ti}_{0.48})\text{O}_3$ (Sakai Chemicals PZT-LQ) of average grain size of $0.5 \mu\text{m}$. It is effectively ground in a ball mill using zirconia balls of 3 mm in diameter in isopropyl alcohol containing an organic surfactant. Its particle size reaches less than $0.2 \mu\text{m}$ after 48 h grinding. It is dried, added with a PVB binder, pressed in a die at a pressure of 80 MPa and sintered in air for 2 h from 1075C to 1200C. The bulk density and dielectric constant of the PZT ceramics sintered at 1075C reach 7.7 g/cm³ and 900 respectively, sufficiently high for industrial applications. Piezoelectric measurements on these ceramics are now in progress.