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MnO_2-added {Pb, Bi, Nd}TiO_3 Ceramics and Their Application to Cylinder Pressure Sensors

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MnO_2-added $\{Pb_{1-3(x+y)/2}Bi_xNd_y\}TiO_3$ ceramics were investigated for their piezoelectric and mechanical properties as applied to cylinder pressure sensors. It was found that 1 mol% MnO_2-added $\{Pb_{0.925}Bi_{0.01}Nd_{0.04}\}TiO_3$ ceramics (PBNT-M) had a high Curie temperature T_c, higher electromechanical coupling factor k_t and mechanical strength σ_{3b} twice that of PZT ceramics, and were very attractive candidate materials for piezoelectric sensors subject to high temperature and static pressure. Their application to cylinder pressure sensors in individual automotive cylinder knocking control systems is reported.

1. Introduction

PZT ceramics are superior piezoelectric materials which have many applications[1,2] in various fields but are not suitable as sensors under high temperature and pressure because of low Curie temperatures T_c and poor mechanical strength. Moreover, $PbNb_2O_6$ ceramics which belong to the tungsten bronze-type[3,4] and bismuth layer-structured compounds[5,6] having high Curie temperatures T_c (T_c = 500 ~ 700°C) are also unsuitable by reason of difficulties in sintering or poor piezoelectric properties.

$PbTiO_3$ ceramics of the perovskite type similar to PZT had been anticipated as