# Piezoelectric Properties of Undoped and Titanium or Barium-Doped Lead Metaniobate Ceramics

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The $PbNb_2O_6$ (PN) is a piezoelectric material with tungsten bronze crystal structure and a high curie temperature. This property is suitable for application in high temperature piezoelectric transducers. However the fabrication of high density PN ceramics is very difficult. In this study Ti- and Ba-doped PN ceramics, ($Pb_{1+x}Ti_xNb_{2-x}O_6$ (PTN) and $Pb_xBa_{1-x}Nb_2O_6$ (PBN) were prepared. Piezoelectric properties, like as $k_t$, $k_p$, $k_{31}$, $k_{33}$, $Q_m$, $d_{31}$, $d_{33}$ were measured and compared between the three materials under study. PN ceramics having a high density (around 96%) and improved piezoelectric constants were obtained through the conventional ceramic method. The permittivity values were higher than those reported in the literature. The properties "pure" PN were comparable to those observed in Ti- and Ba-modified PN ceramics. However, the addition of Ba to the PN ceramics decreases the Curie temperature (as compared to PN), limiting their applicability in piezoelectric transducers at temperatures under 300$^o$C. On the other hand, the addition of titanium not only shifts the PN's Curie temperature to higher temperatures, but also contributes to increase the densification of PN ceramics. The results are discussed viewing the potential of these ceramics to be used in the fabrication of piezoelectric transducers of high temperature applications.