CHAPTER 2
PURPOSES OF THE RESEARCH

The purpose of this thesis was to identify compositions in the PNN-PZN-PZT system for use in applications such as actuators, transducers, sensors, and capacitors, and to investigate the influence of ceramic processing routes on the stability of the perovskite structure and the dielectric and piezoelectric properties. Since relaxor ferroelectrics show diffuse phase transitions with a broad dielectric peak, and normal ferroelectric materials show a sharp phase transition with a sharp dielectric peak, the dielectric properties of mixed solid solutions of normal and relaxor ferroelectric ceramics were studied. The initial objective of this study was to provide a comprehensive examination of the process-property relationships in the binary system of relaxor ferroelectric PZN with normal ferroelectric PZT over a wide composition range. Both the conventional mixed-oxide and columbite precursor methods have been used in synthesizing PZN–PZT ceramics. A comparison of the important ferroelectric properties was made to identify the optimum processing conditions. The next objective was to stabilize phase-pure perovskites in PNN-PZT and PNN-PZN-PZT solid solutions by using the columbite precursor technique. The dielectric behavior, and ferroelectric and piezoelectric properties were extensively investigated. Many compositions were found to be excellent candidates for ultrasound and sonar applications, due to large electromechanical coupling coefficients. Some compositions were found to have excellent electrostrictive properties and very little hysteresis. Based on the data that was collected in this study, new phase diagrams were

constructed for the PZN-PZT and PNN-PZT systems. The locations of the morphotropic phase boundaries were determined by examining the temperature and compositional dependence of the dielectric properties, x-ray diffraction data, and ferroelectric and piezoelectric properties.