Non-Confidential Description - PSU No. 2259
“Perovskite Materials for High Temperature and High Performance Actuators and Transducers”

Keywords:
Perovskite, piezoelectric sensors, high temperature, actuators, transducers

Links:
Inventor website
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Background
Piezoelectric sensors and actuators have experienced tremendous growth and wide spread application since the initial work with Pb(Ti,Zr)O3 (PZT) in the early 1950's. Since then, PZT-based piezoelectric devices have dominated the world market. They are widely used in underwater sonar, vibration dampening equipment, medical ultrasound transducers, high frequency buzzers and speakers, fuel injection actuators, and precision positioners. Recently there has been interest in incorporating these devices into "Smart Systems" or "Smart Structures," utilizing these devices’ dual nature as both a sensor and an actuator. Some proposed applications are for variable control surfaces or noise/vibration suppression in aerospace and automotive applications. However, the current temperature limitations of PZT-based devices have restricted these types of applications. The PZT-based devices are limited by the Curie temperature of these materials; the temperature indicating the complete loss of piezoelectric properties, typically less than 3500 C.

Invention Description
The present invention is directed to a new family of high Curie temperature, morphotropic phase boundary systems, based on the perovskite solid solution having the general formula (1-x) BiMeO3-xPbTiO3, where Me is a suitably sized cation or combination of cations and x is a molar fraction. The perovskite systems of the present invention offer room temperature properties analogous to, and high temperature properties superior to, commercially available PZT compositions. The perovskite of this invention exhibits a MPB between the rhombohedral and tetragonal phases. Further dopant strategies may be used for property optimization of the perovskite systems.

Advantages/Applications
• Superior high-temperature piezoelectric performance, allowing use in high-temperature applications previously untenable