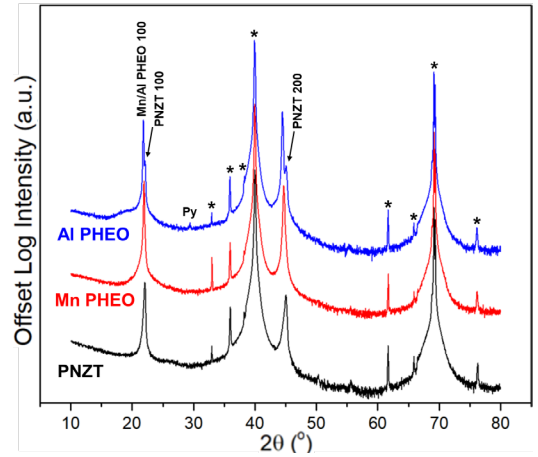
Electrocaloric Effect of Perovskite High Entropy Oxide Films

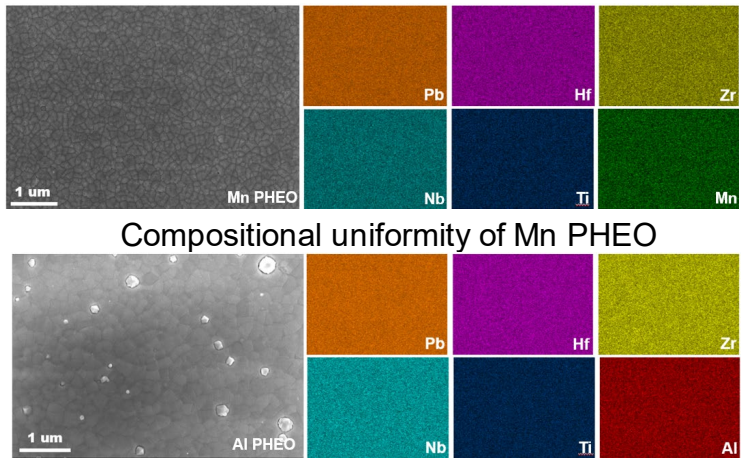
Y. Son and Susan E. Trolier-McKinstry, Penn State University

A new perovskite high entropy oxide relaxor-ferroelectric material has been synthesized. The compositions fabricated are $Pb(Hf_{0.2}Zr_{0.2}Ti_{0.2}Nb_{0.2}Mn_{0.2})O_3$ (Mn PHEO) and $Pb(Hf_{0.2}Zr_{0.2}Ti_{0.2}Nb_{0.2}Al_{0.2})O_3$ (Al PHEO) and their structural, electrical, and electrocaloric properties have been explored to ascertain what effect that local structural disorder has on the stabilization of long range ferroelectric ordering, as well as on the electrocaloric effect.

This material enabled an electrocaloric temperature change of 8.4 kelvin. The electrocaloric effect (temperature change) can be used for future cooling technology that is greenhouse gas free, high efficiency, and miniaturizable.

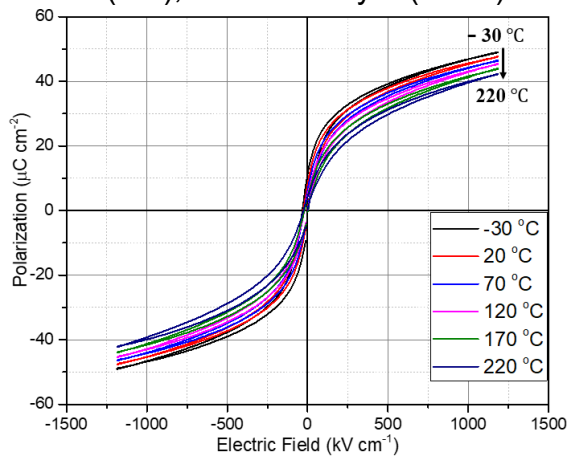


X-ray diffraction of Al PHEO (blue), Mn PHEO (red), and seed layer (black)

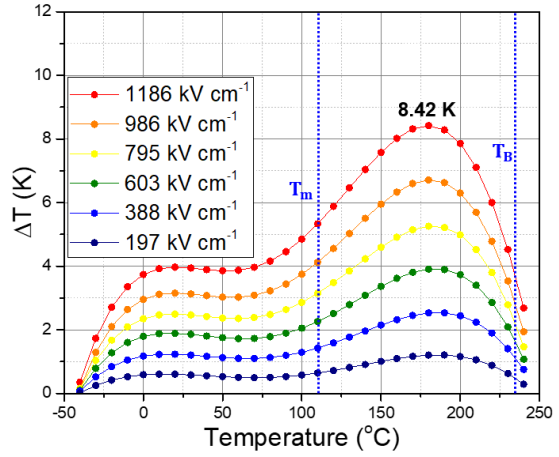


Compositional uniformity of Mn PHEO

Compositional uniformity of Al PHEO



Polarization vs Temperature of Al PHEO



Electrocaloric Temperature change of Al PHEO