inherent to high entropy oxides. Such properties include thermal conductivity, specific heat, and toughness.

## SUMMARY

**[0008]** ~~In example embodiments, t~~The present disclosure provides a class of oxide coating compositions that can be applied via thermal spray techniques to engine components of any composition, which exhibit low thermal inertia and effective temperature swing properties. The coating allows for increased fuel efficiency in combustion engines.

**[0009]** Examples ~~embodiments~~ of the present disclosure relate to a high entropy oxide (HEO) material as temperature swing coating. In one aspect, there is provided a high entropy oxide (HEO) material comprising a thermal conductivity lower than 1.5 W $m^{-1}$ $K^{-1}$. In ~~embodiments~~examples, the HEO material allows for precise tunability of chemical, mechanical, and thermal properties for use in specific environments. In examples~~embodiments~~, HEO materials contain high concentrations (>5 mol%) of at least five oxide constituents. The chemical disorder in the oxide systems creates significant phonon scattering leading to an inherently low thermal conductivity. Compositional control allows for compositions with low specific heat capacity and, therefore, low thermal inertia, which is defined as the square root of the product of the heat capacity, thermal conductivity, and density.

**[0010]** The compositions that maximize atomic size and mass variance provide the most phonon scattering and the lowest thermal conductivity. Compositions with the lowest average atomic mass have the lowest specific heat capacity and density. The proper combination of low thermal conductivity and low heat capacity provides the disclosed oxides with low thermal inertia and good temperature swing properties.

**[0010a]** In another aspect, there is provided an HEO material comprising: 0.4-0.6 wt% MO oxides; 1.2-1.8 wt% $Y_2O_3$; 5.5-9 wt% $M_2O_3$ oxides; 2-4 wt% $MO_2$ oxides; and a balance of $ZrO_2$.