Lanthanum cobaltite as a metallic oxide interconnect in thermoelectrics

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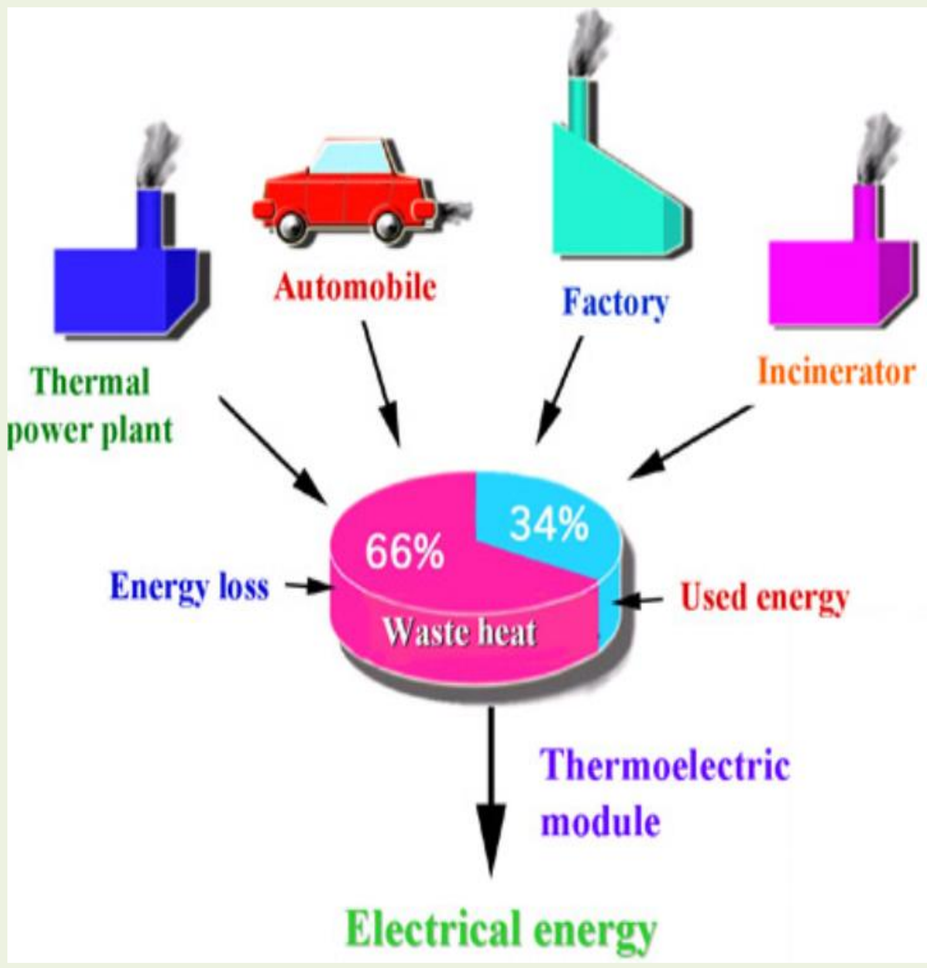
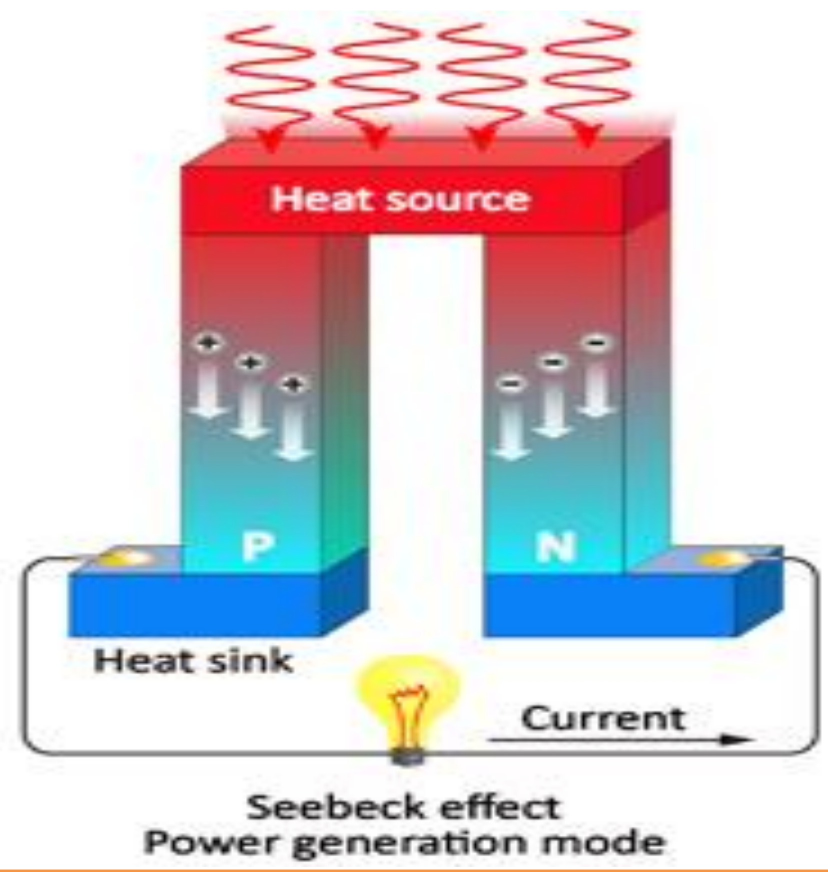
FERMiO SMN THERMiO UiO innovation cluster

1. Introduction



In 1821, Thomas Seebeck found that an electric current would flow continuously in a closed circuit made up of two dissimilar metals, if the junctions of the metals were maintained at two different temperatures.

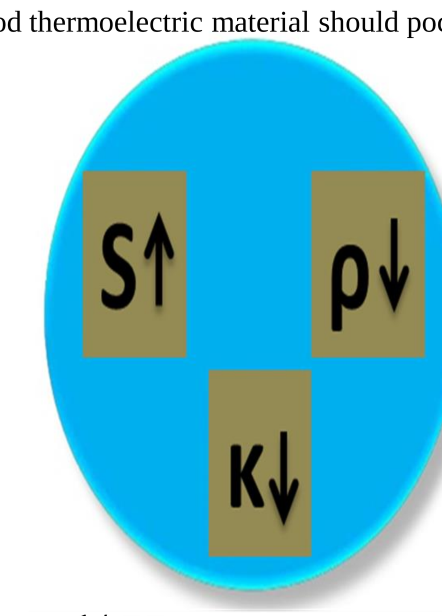


1.Figure of Merit

$$ZT = \frac{S^2T}{\rho\kappa}$$

S, Seebeck coeficient,
ρ, Electrical resistivity and
κ, thermal conductivity

A good thermoelectric material should pocess



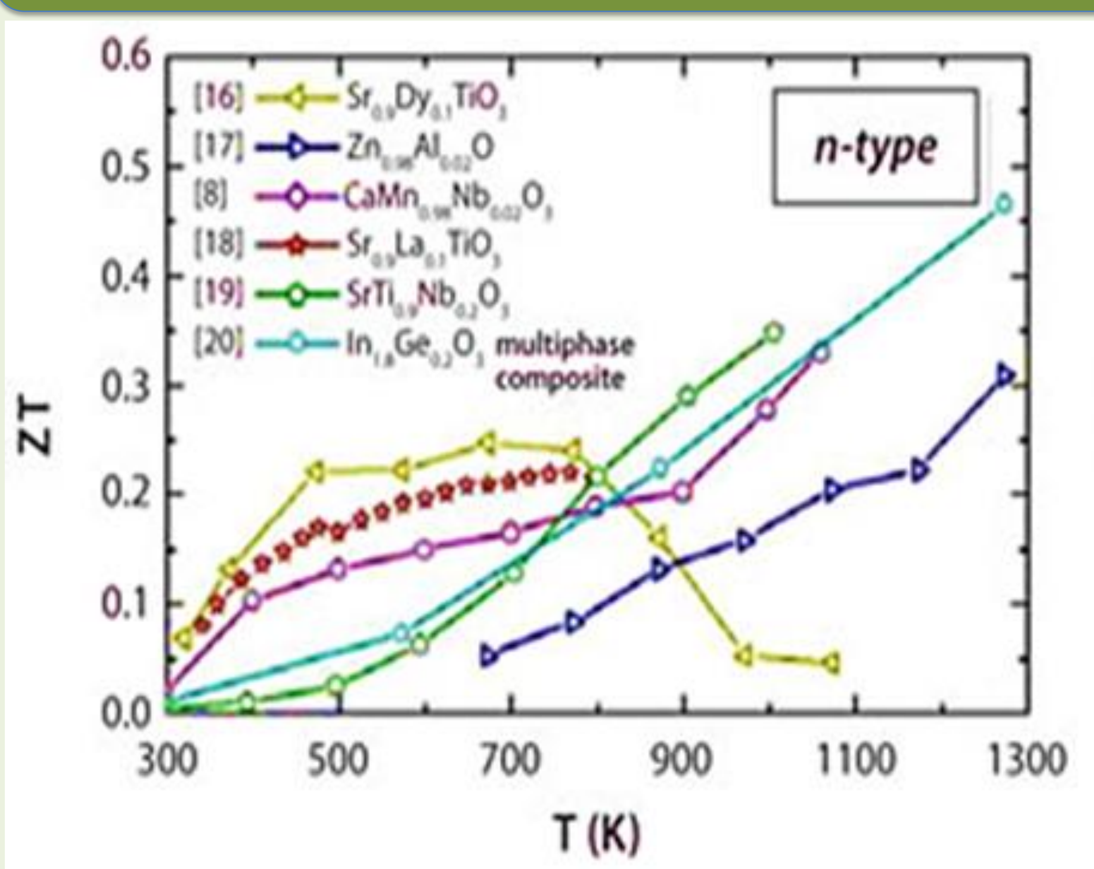
2.Power factor

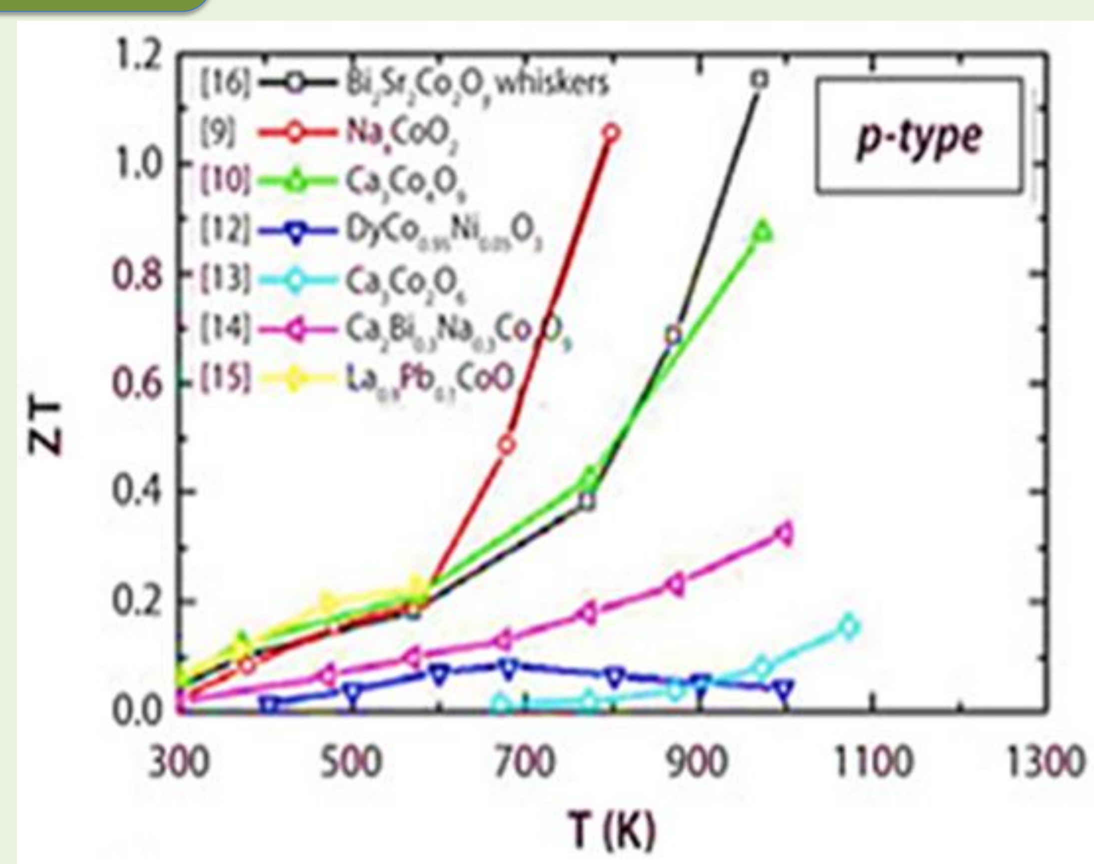
Power factor = σS^2
σ, Electrical conductivity

3.Device efficiency

η= Energy provided to the load/ Heat energy absorbed at the hot junction

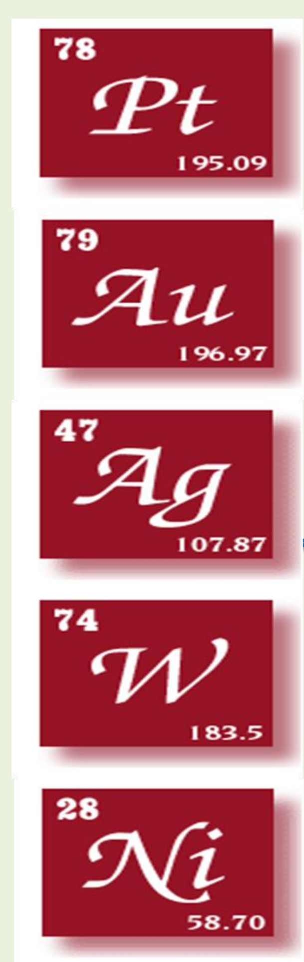
2. Oxide thermoelectric materials





- ✓Low κ
- ✓High S
- ✓High thermal and chemical stability
- ✓Environment friendly
- ✓Abundant

Main Challenge : Lower ZT range



Matching the coefficient of thermal expansion

Bonding and interface reaction

Specific contact resistivity

- ❖Metal diffuse at high temperature
- ❖High contact resistance at the junction
- ❖Cracking/ evaporation of metal contact
- ❖High cost

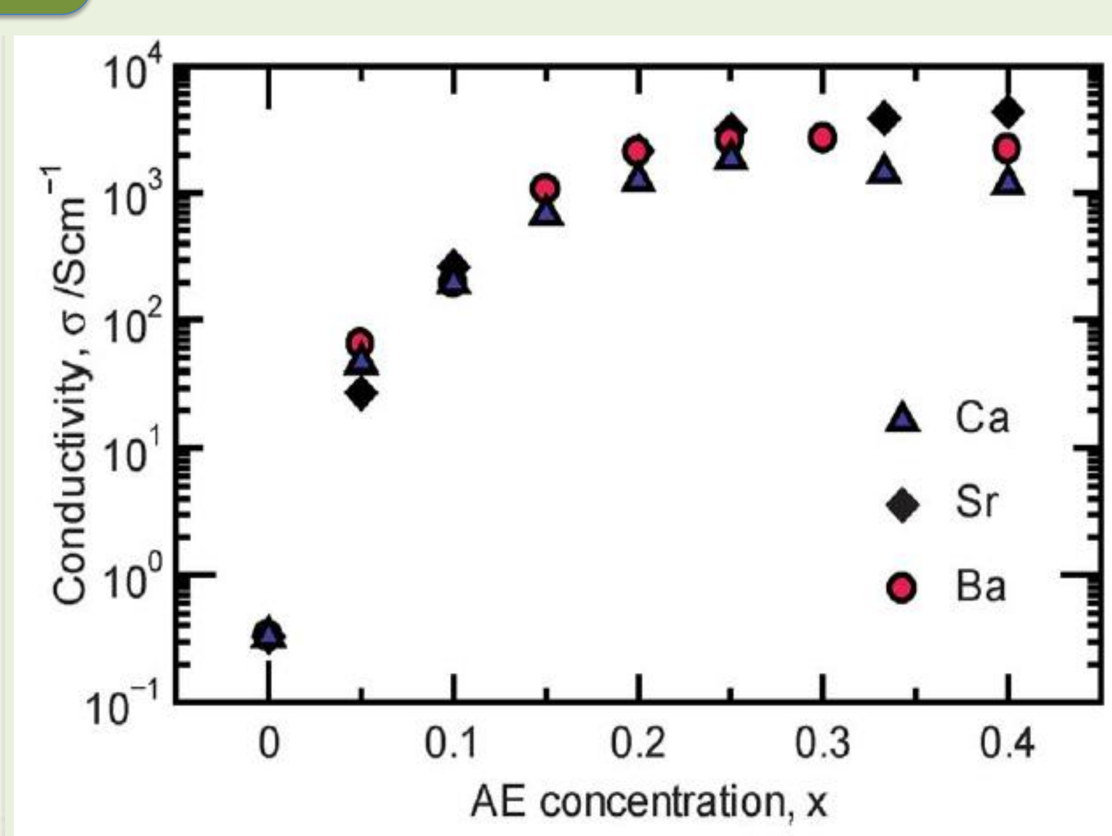
Conducting oxides

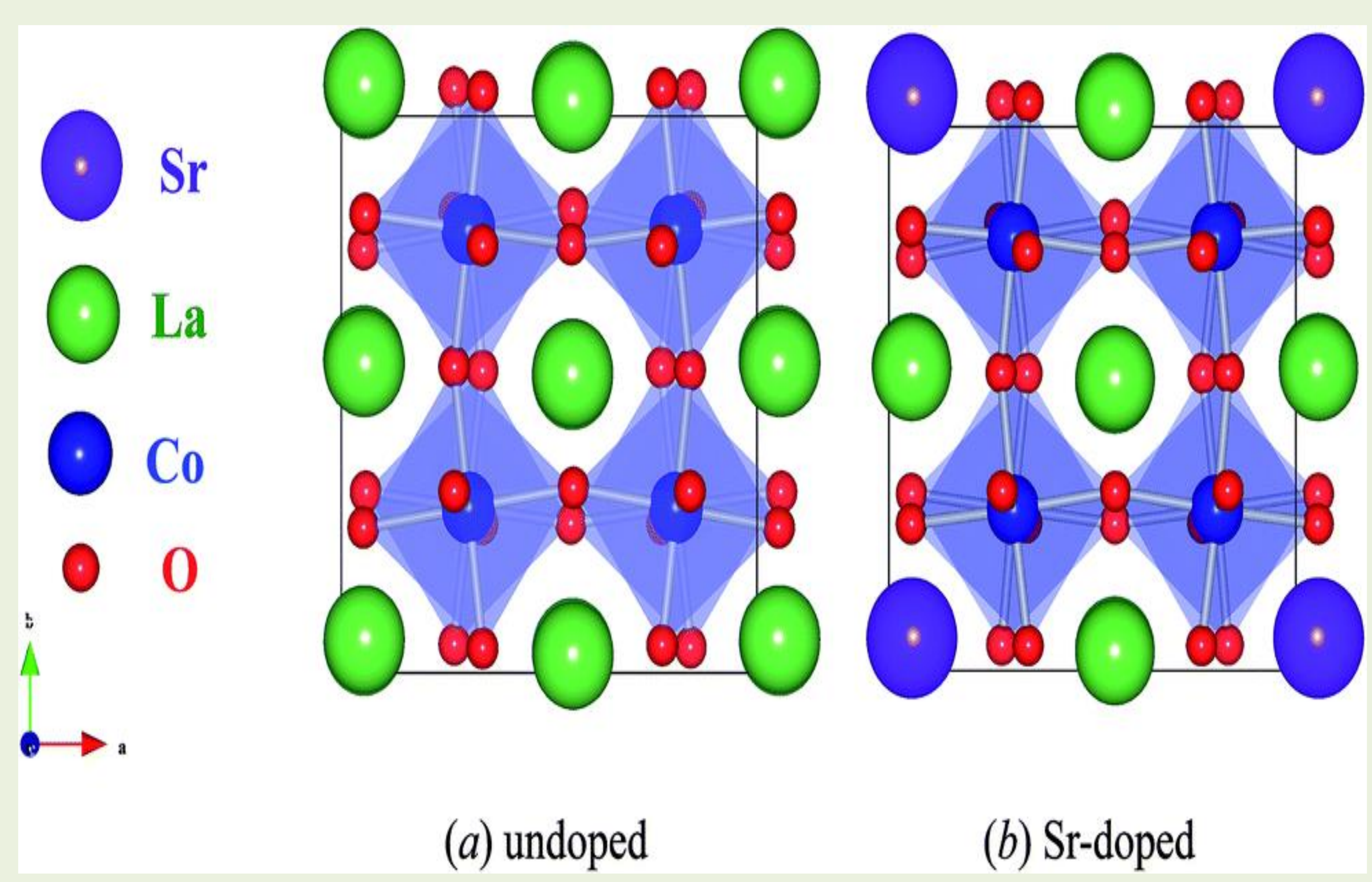
- High thermal stability
- High resistance to chemical corrosion
- Favorable integration with TE oxide

p-n oxide thermoelectric junctions still need an ohmic contact: Noble metal? Or metallic oxide?
In this project, we will investigate alkaline earth doped $LaCoO_3$ as metallic oxide interconnect.

3. Alkaline earth doped $LaCoO_3$

- High, metallic conductivity
- Low cost
- High thermal stability





Electrical conductivity has a maximum, $\sigma=4.4\times10^3$ S cm^{-1} in $La_{0.6}Sr_{0.4}CoO_3$

4. References

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3. Petrov, A.N., et al., *Solid State Ionics*, **1995**. 80(3) 189-199.