Nanocomposite Thermoelectric Design

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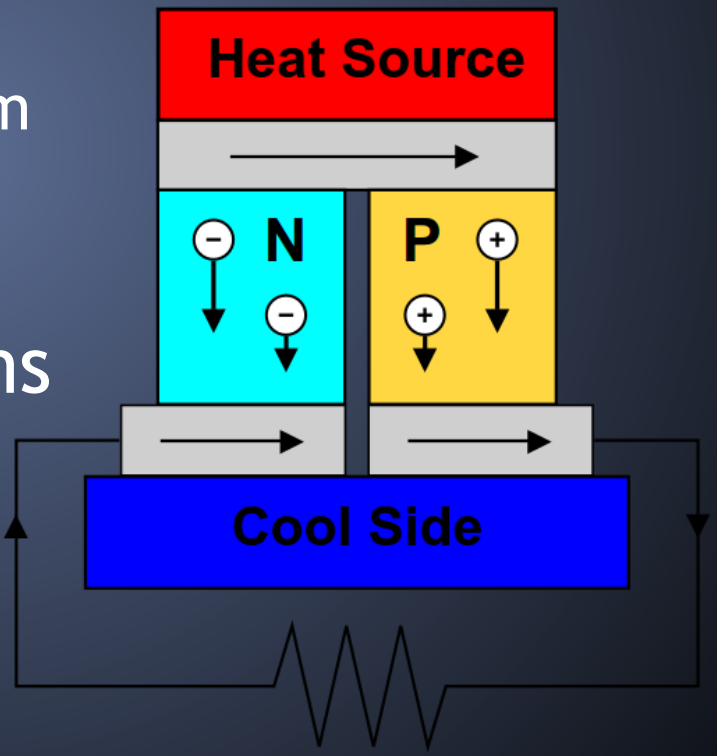
What is a thermoelectric?

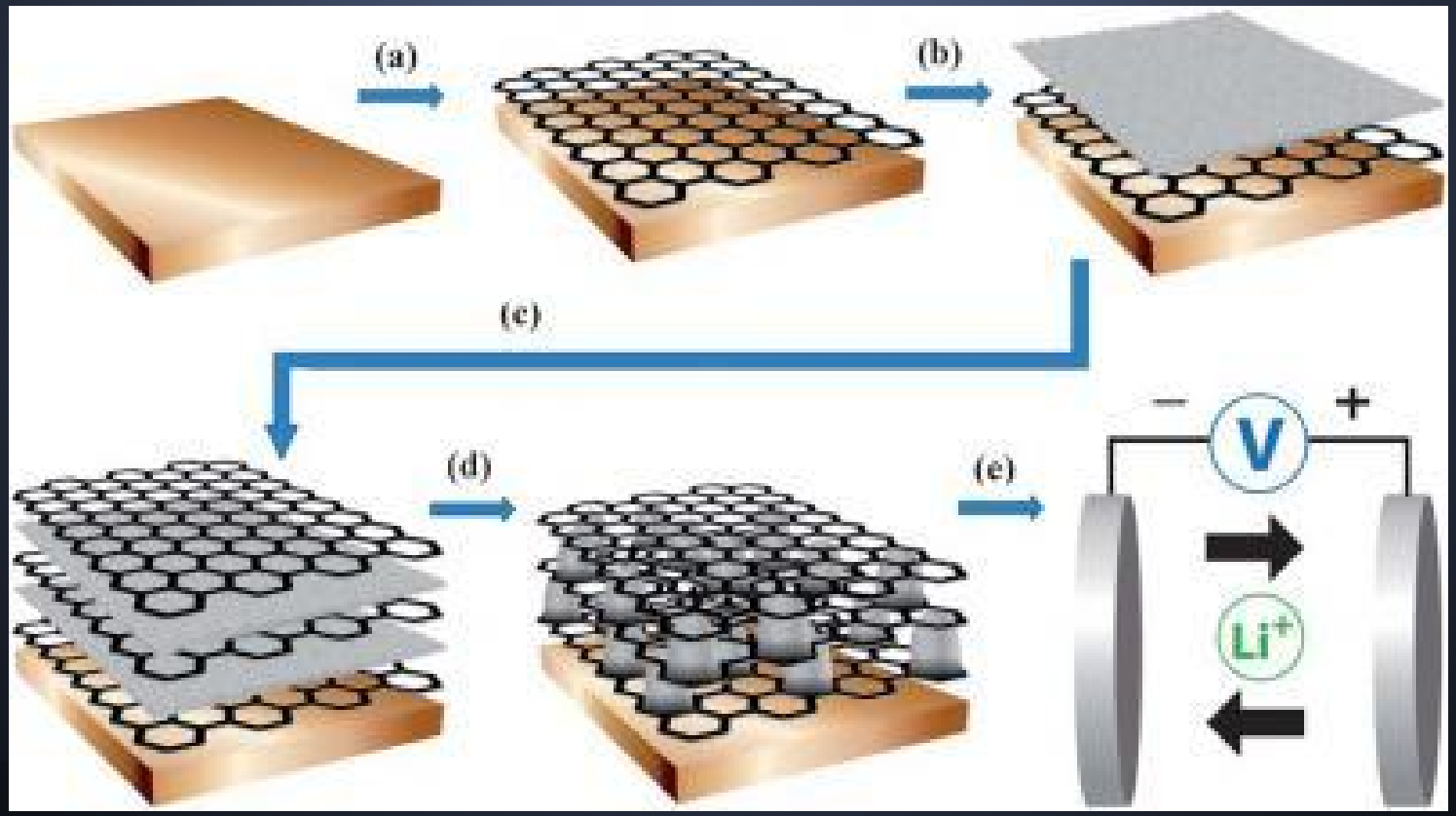
- Heat -> Electricity (Seebeck effect)
  - Electricity -> Cooling (Peltier)
- Carnot engine limits
  - Charge carriers like steam
- 2 Heat carriers
  - Electrons, phonons
- 5 Transport mechanisms



Thermoelectric Generator

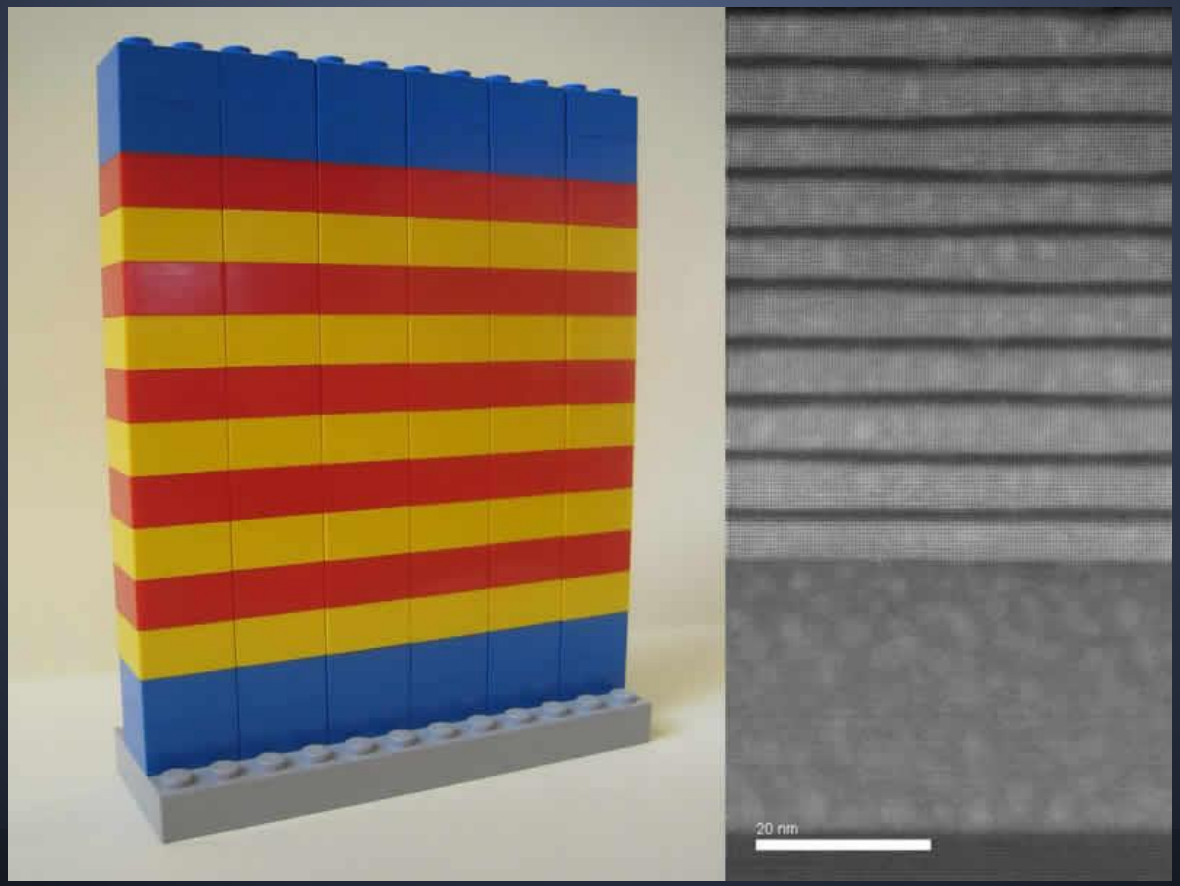
What is a nanocomposite?

- Artificial nanoscale structures



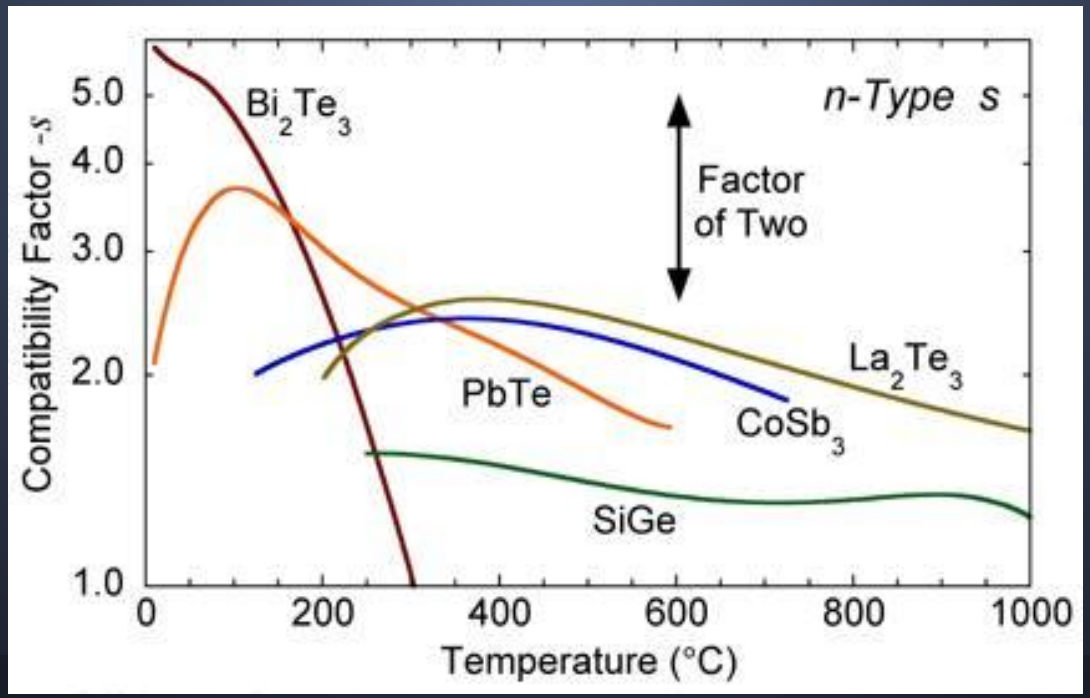
Superlattice

- 3D structure of 2D layers (nano-sandwich)



History of Thermoelectrics

- 1821 Seebeck discovers thermoelectricity
- 1960's bulk materials - Bi_2Te_3, PbTe, SiGe
- 1990's nanocomposites



thermoelectrics.caltech.edu

Thermoelectric Theory

- $ZT = S^2\sigma T \div (K_{electron} + K_{phonon} + K_{bipolar})$
  - $ZT \propto$ Total conversion efficientcy
  - Necessary compromise between variables
- PGEC fundamental

Aims

- Understand the nature of thermal conductivity due to phonons
- Develop a kinetic theory of PGEC
- Propose nanocomposite structures for PGEC
- Computationally model proposed nanocomposite structures

References

CRC Handbook of Thermoelectrics - D. M. Rowe

General things I’m going to add

- Something describing phonons with a nice picture (video?)
- A slide about PGEC, describing the concept in more detail
- More about kinetic theory and the assumptions we need to make for it
- Few more graphs about the efficiency and prior work on thermoelectrics
- More pictures in general
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