

THERMOELECTRIC COOLING

Thermoelectrics for a low energy
thermal management

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EL ARTE DE REFRIGERAR



TERMOELECTRICIDAD

JOSPEL General Objectives – COOLING

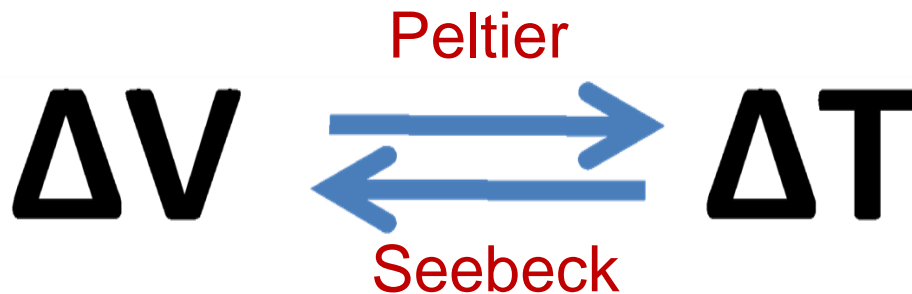
- Development of a novel and innovative cooling system based on the use of Peltier effect. Reduction of energy consumption of passenger cooling system at least 25% in comparison with current heat pump (compressor) inverter.
- To develop a heat pipe embedded solution that will allow minimizing the electric consume of the system while achieving the maximum COP (coefficient of performance).
- To analyse the integration of the thermoelectric system on the vehicle. Location of the spots that will ensure the best thermal comfort possible.



But... what thermoelectrics are?



T. Seebeck (1821)



J. C. A. Peltier (1834)

$$\Pi = S \cdot T$$

$$ZT = \frac{\sigma S^2}{\lambda} T$$

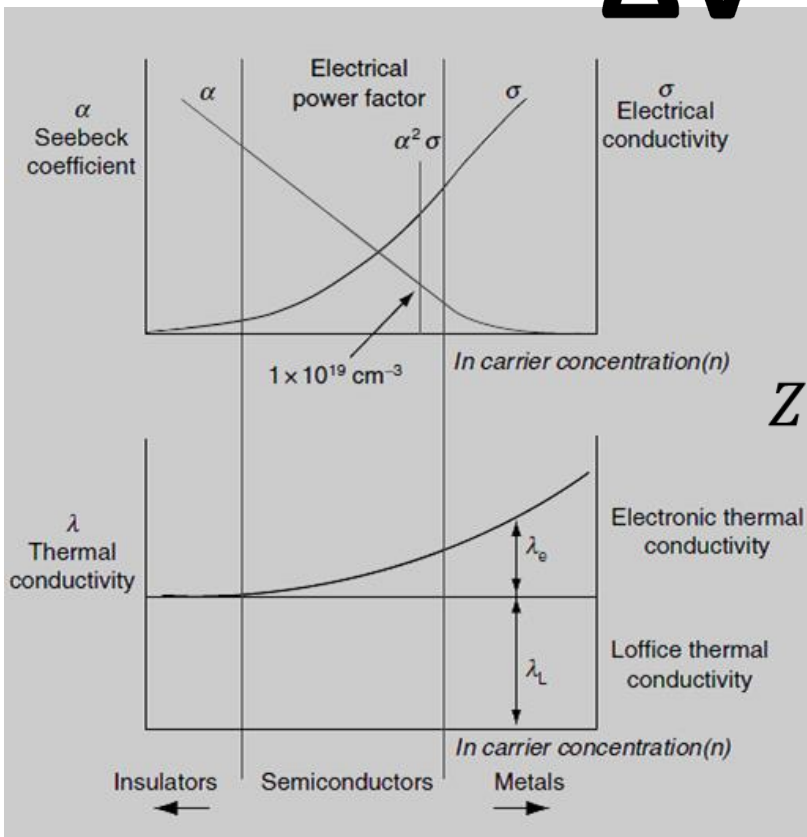
S: Seebeck coefficient dV/dT

σ : Electrical conductivity

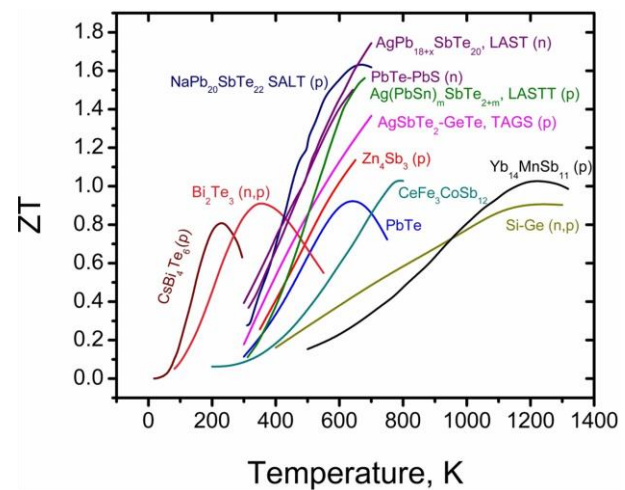
λ : Thermal conductivity

But... what thermoelectrics are?

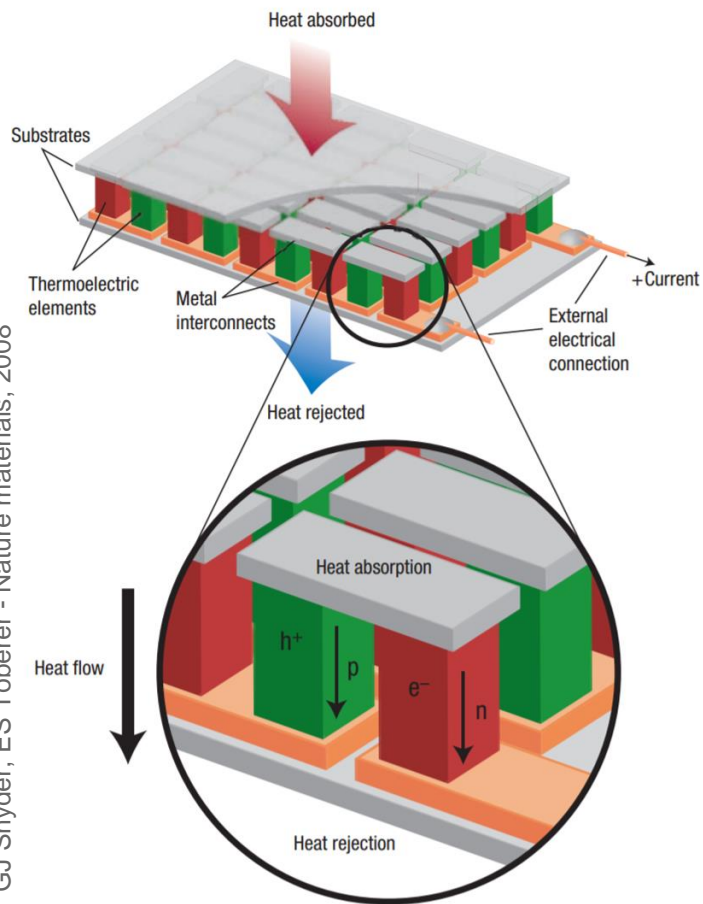
$$\Delta V \rightleftharpoons \Delta T$$



$$ZT = \frac{\sigma S^2}{\lambda} T$$



But... what thermoelectrics are?



GJ Snyder, ES Toberer - Nature materials, 2008



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cooling

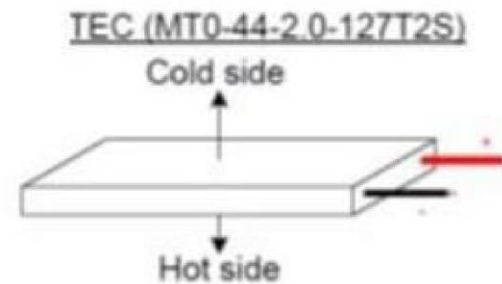
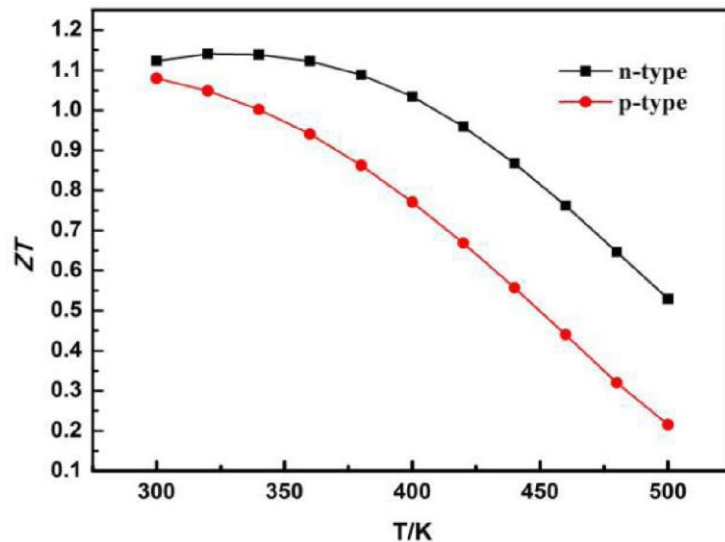
Why thermoelectrics?

- **No moving parts** make them very **reliable**.
- **Maintenance-free**.
- **Environmentally friendly**.
- Ideal when **precise temperature control** is required. Wide operating temperature range.
- **Acoustically silent** and electrically quiet.
- Able to operate in **any orientation**, zero gravity and high G-levels.
- **Compact size** and **lightweight**.
- Ability to alternate between heating and cooling.
- Excellent cooling alternative to vapor compression coolers for systems that are sensitive to mechanical vibration or for **low power** consumption.



Cooling in JOSPEL

Bi₂Te₃-based

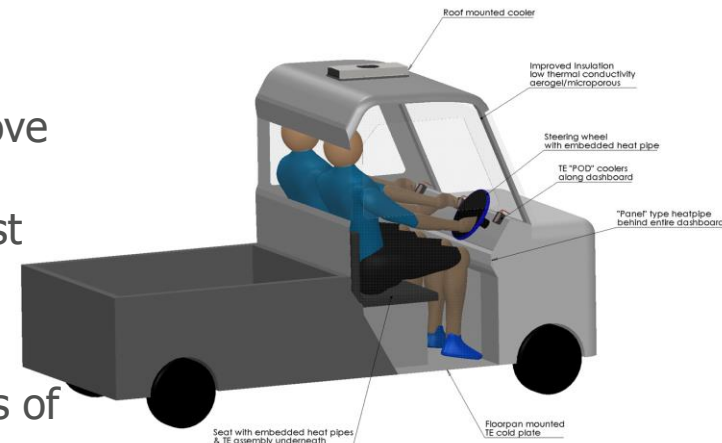


Current max.	2.0 A
Voltage max.	12 V
Cooling Power (at Th=25°C)	Max 20 W
Width	42 mm
Length	30 mm
Thickness	3 mm

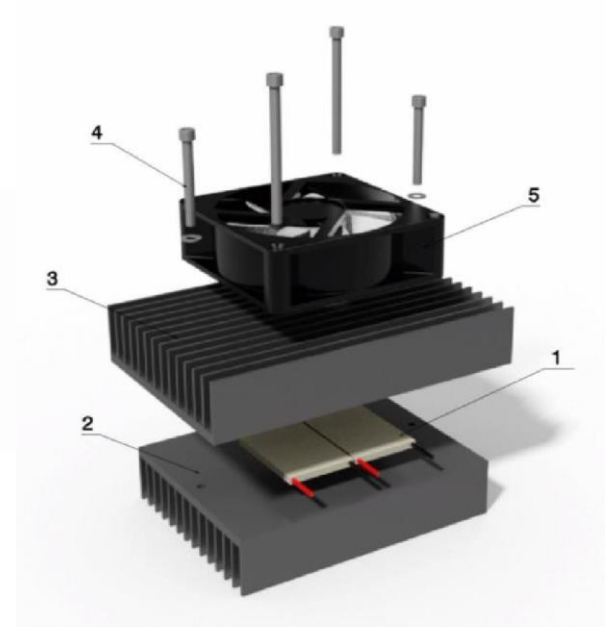
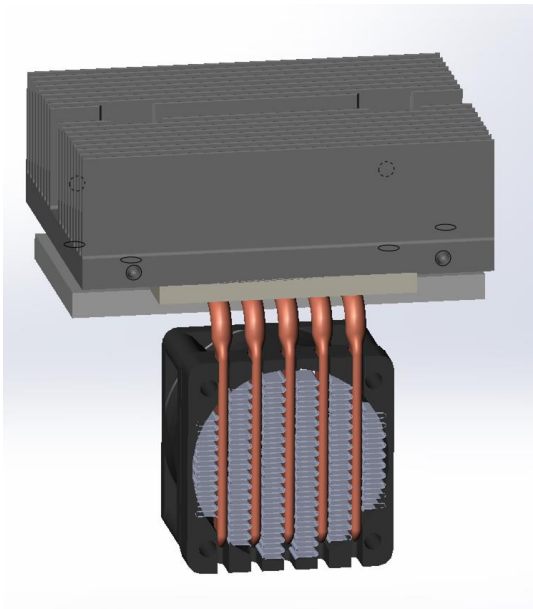
Cooling in JOSPEL

**Focused on two major concepts:
Insulation and contact cooling.**

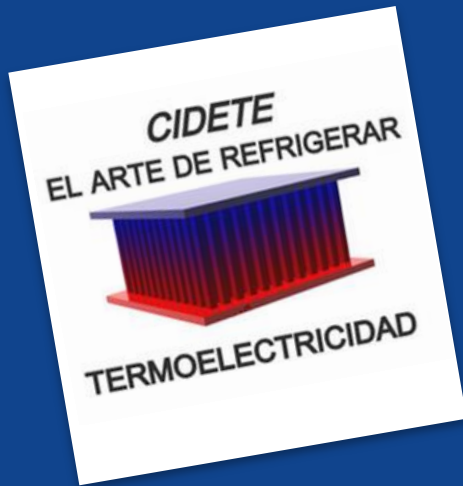
- One major feature of the vehicle cabin that will improve the performance of any additional cooling system is proper insulation, by insulating the cabin with the best performing materials we are minimising the effect of external temperatures to the cabin.
- Thermoelectrics can be used to cool in localised areas of the passenger compartment and most effectively if the passenger can be cooled directly. This can be used to give a cooling effect on the passengers particularly when applied to areas of the body that give the feeling of temperature reduction more efficaciously.



Cooling in JOSPEL



Cooling Objective	Means of verification	Real % achieved
<p>Development of a novel and innovative cooling system based on the use of Peltier cells. Reduction of energy consumption at least 25% in comparison with current heat pumps (compressor) inverter.</p>	<p>Maximum power installed 875 W</p>	<p>80% completed - 20 % reduction in comparison with current solutions - Actual power installed 935 W</p>



Thank you for your attention!

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