

Solar Cell and Thermoelectric Technologies



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Harvesting solar energy to electricity **Solar Cells**



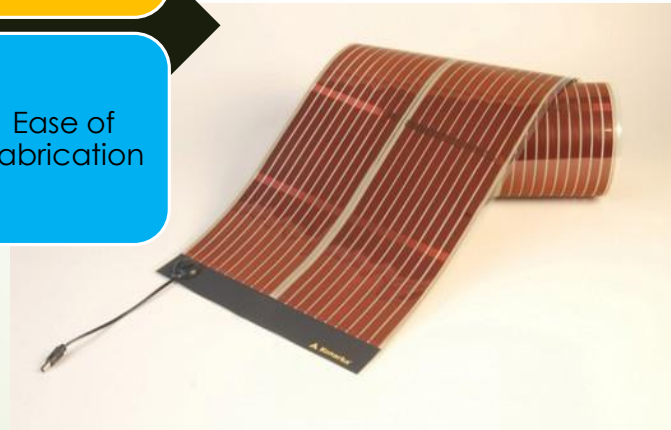
Silicon Solar Panel

Low Cost

Flexibility

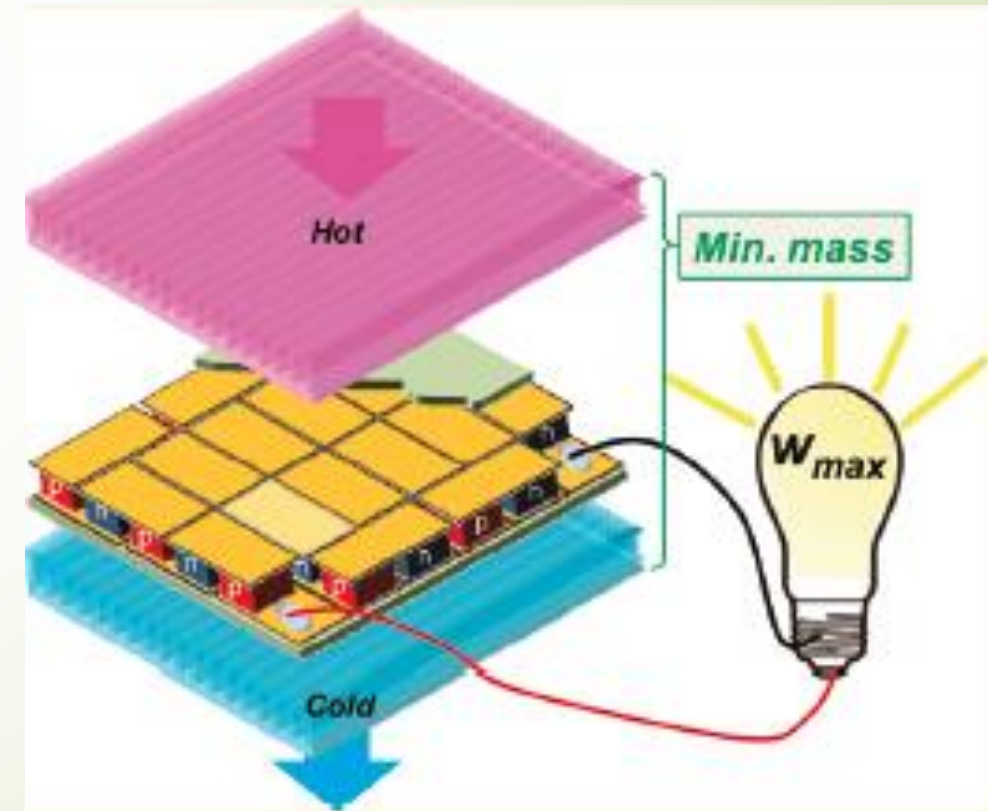
Light Weight

Ease of Fabrication



Organic-based Solar Panel

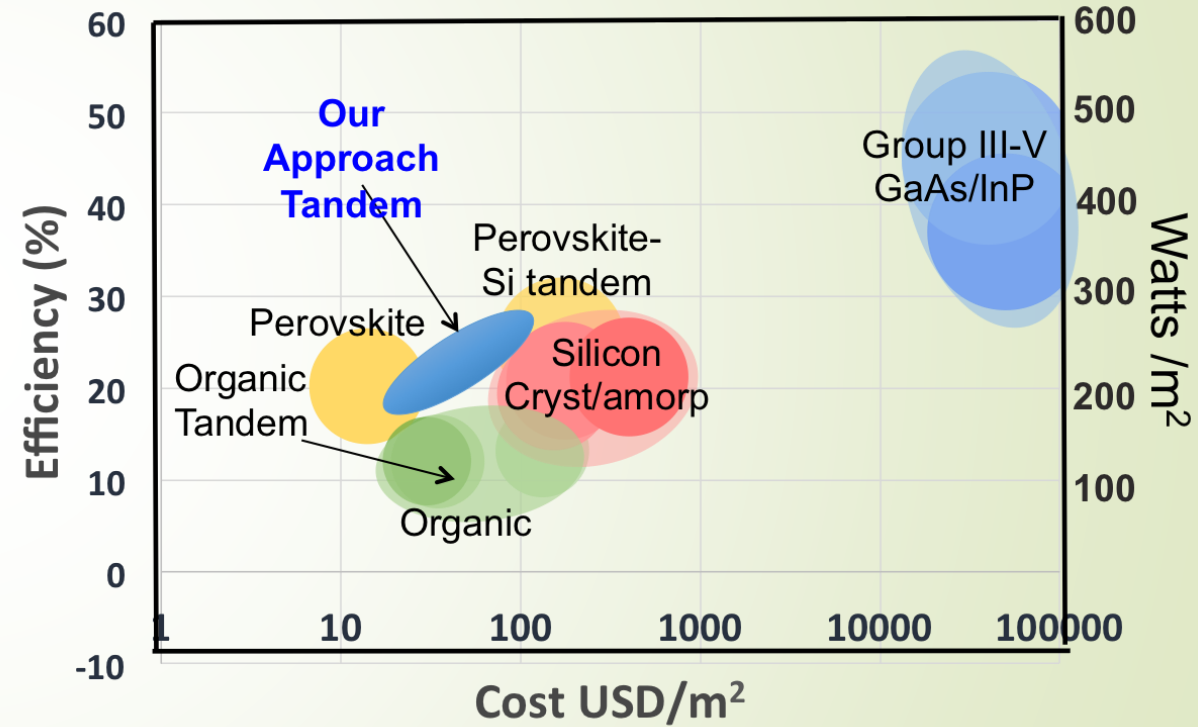
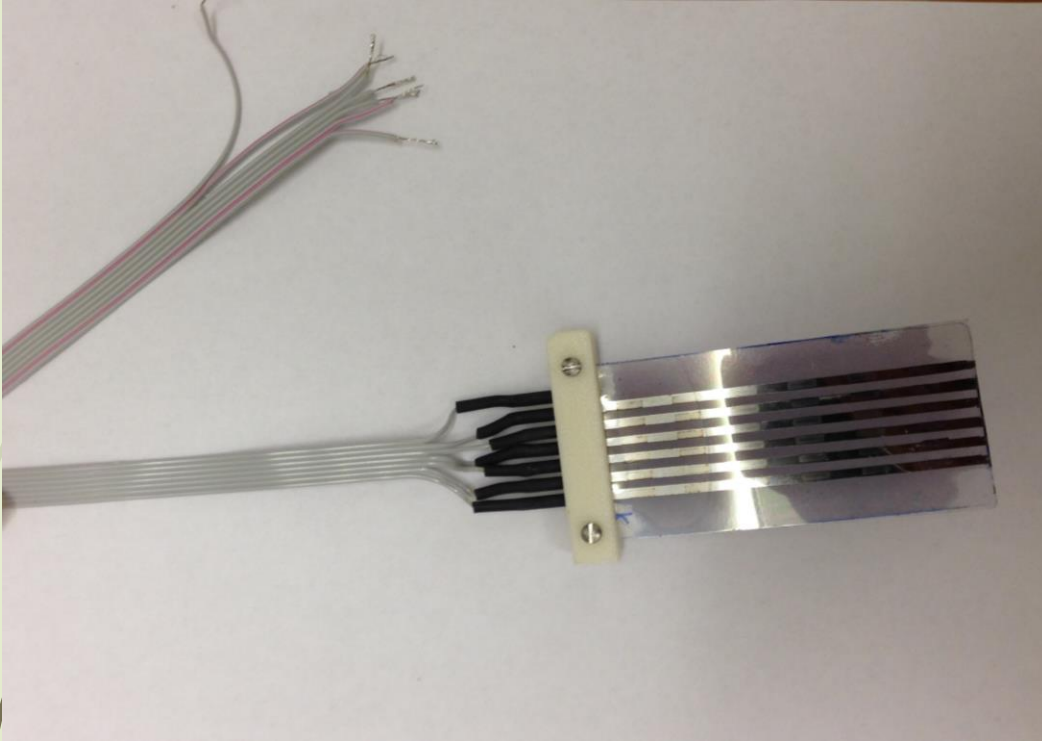
Harvesting waste heat to electricity – **Thermoelectric Generators**



A Cost Comparison of Competing Power Generation Technologies

Application Temperature	Power Generation Technology	System Cost (\$/W)
Low ($T_h \approx 100\text{ }^\circ\text{C}$)	Geothermal	\$4.14
	Half-Heusler Thermoelectric (Bulk $Zr_{0.25}Hf_{0.25}Ti_{0.5}NiSn_{0.994}Sb_{0.006}$)	\$125.05
	Silicon Nanowire Thermoelectric	\$104.18
	Chalcogenide Thermoelectric (Nanobulk $Bi_{0.52}Sb_{1.48}Te_3$)	\$62.44
Medium ($T_h \approx 250\text{ }^\circ\text{C}$)	Organic Rankine Cycle	\$4.00
	Concentrating Solar Power	\$3.60
	PV Target	\$1.00
	Skutterudite Thermoelectric (Bulk $Yb_{0.2}In_{0.2}Co_4Sb_{12}$)	\$19.02
	Half-Heusler Thermoelectric (Bulk $Zr_{0.25}Hf_{0.25}Ti_{0.5}NiSn_{0.994}Sb_{0.006}$)	\$14.45
	Chalcogenide Thermoelectric (Nanobulk $Bi_{0.52}Sb_{1.48}Te_3$)	\$11.92
High ($T_h \approx 500\text{ }^\circ\text{C}$)	Nuclear	5.34
	Coal	\$2.84
	Natural Gas	\$0.98
	Silicide Thermoelectric (Bulk $Mg_2Si_{0.6}Sn_{0.4}$)	\$5.56
	Chalcogenide Thermoelectric (Bulk $AgPb_{18}SbTe_{20}$)	\$5.06
	Half-Heusler Thermoelectric (Bulk $Zr_{0.25}Hf_{0.25}Ti_{0.5}NiSn_{0.994}Sb_{0.006}$)	\$4.48

Solar Cells – Current Technology Development Stage

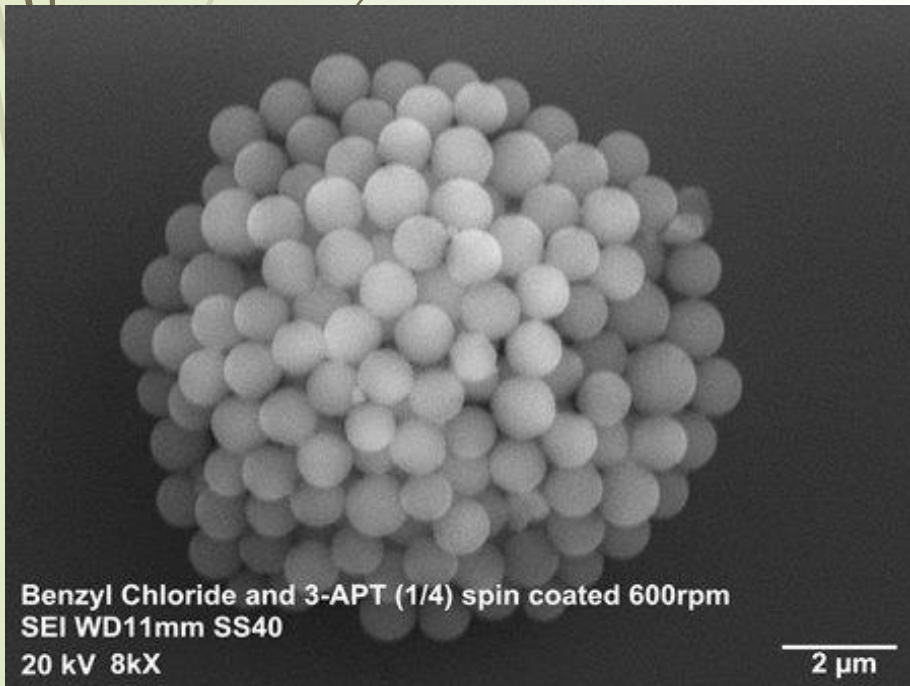


Space Technologies – Space Solar Power



Juno's MJ III-V cell solar panels convert up to 28% of sunlight into power. Future space exploration missions will require lighter, flexible, less expensive, and more efficient solar panels to operate in LILT conditions.

Experiments on the ISS - ACE-H2 Begins Flight Operations - 01/2015



Thermoelectric Generators – Current Technology Development Stage

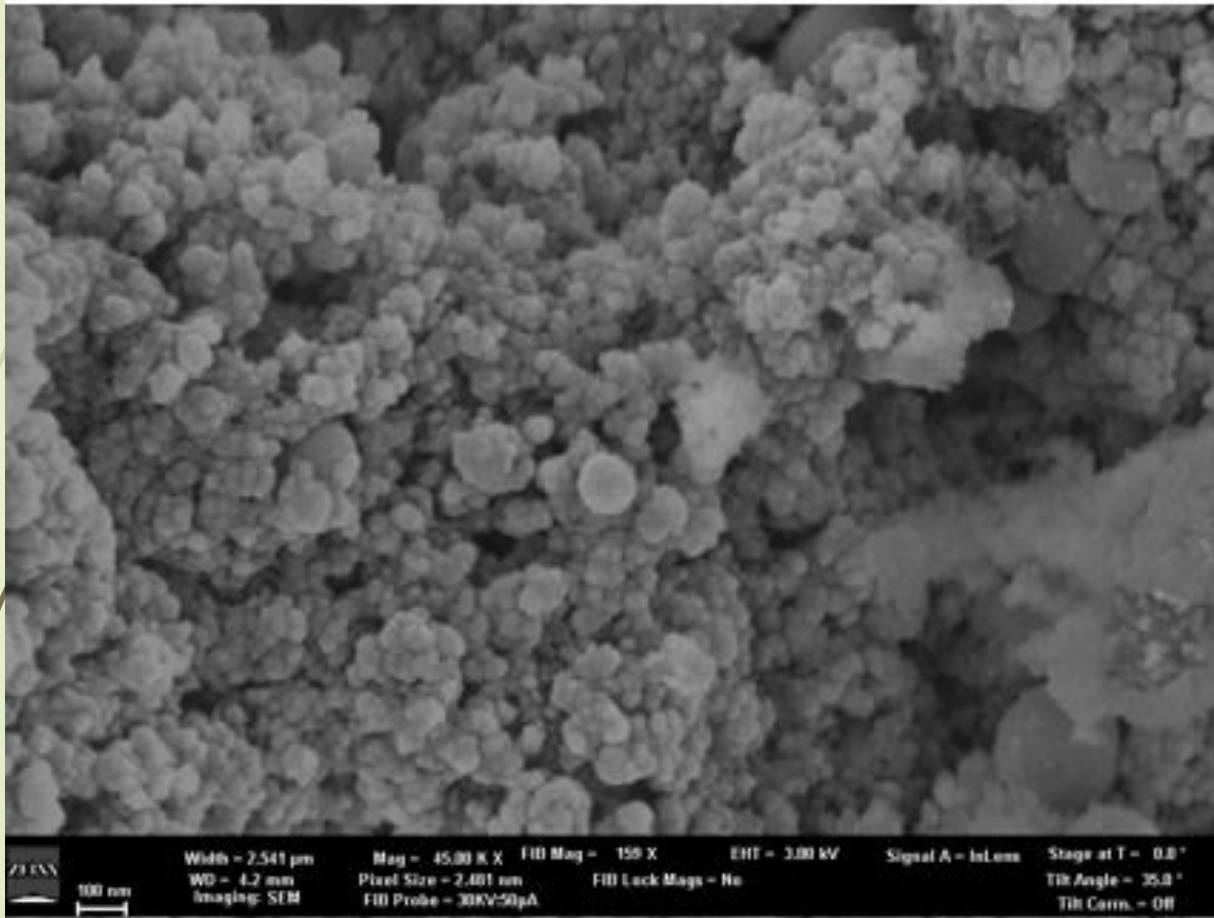
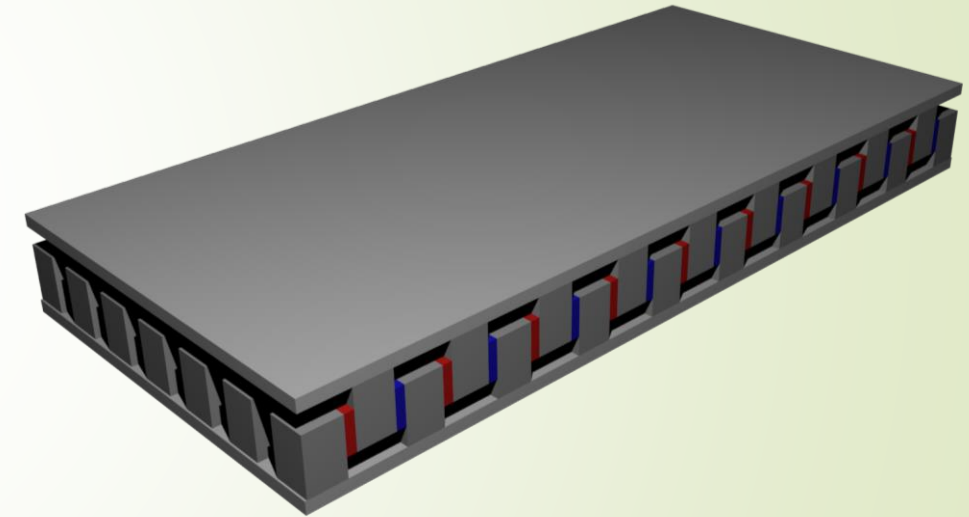


Image 15; RY031, file: RY031_12



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