Nanophotonics for solar-thermal applications
Nanophotonics:

optical properties determined from nano-structure
(rather than properties of the material)
Application opportunities for tailoring thermal radiation: frequency selective solar absorbers


Solar water heater

Solar-thermal energy conversion

Natural energy storage
(high-T → high efficiencies)

High T ⇒ material choice very limited

“Selective Solar Absorbers”
P. Bermel, J. Lee, J. D. Joannopoulos, I. Celanovic, and M. Soljacic
THE challenge for high-T nanophotonics: high-T, long-time stability

Optics Express 21, 11482, (2013).
Solar TPV

- Sun radiation
- Concentrator
- Emitter (PhC)
- Thermally emitted (PhC)
- PV cell
- Electrical power

Electronic bandgap of the PV

~80% efficiency
Solar TPV - first experiments

A. Lenert, D. Bierman, Y. Nam, W. Chan, I. Celanović, M. Soljačić and E. Wang
Angular control of light
“Building blocks” for controlling light

- **Color selectivity**
- **Polarization selectivity**
- **Angle selectivity**
Applications of angular selectivity

Solar applications:
• Solar-thermal conversion (TE, TPV, mechanical...)
• Thin-film PVs
• Conventional PVs (even narrow bandwidth helps)

Atwater group: *LSA 2013, IEEE Jour.PV 2015*

⇒ ~1200°C TPV-operation *without* solar concentration
"Optical Broadband Angular Selectivity"
Science, 343, 1499 (2014).
White light: angle-discrimination
Thank you!

marin@alum.mit.edu
www.mit.edu/~soljacic