

Simultaneous harvesting of radiative cooling and solar heating for thermoelectric generation

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Radiative cooling in outdoor is a passive method to cool the surface facing the sky. Particularly during the past decade, numbers of successful demonstrations on daytime radiative coolers have been reported. As a daytime radiative cooler can be radiatively cooled not only in day but also in night, it is always cooled and generates temperature difference against the surrounding temperature. This temperature difference can be used to generate thermoelectric power whole day by placing a daytime radiative cooler on a thermoelectric module.[1] However, with this design, a daytime radiative cooler is not using solar energy as it reflects back to the sky. With an advanced design, a thermoelectric device can simultaneously harvest radiative cooling and solar heating. The key component is a vertically placed transparent thermoelectric module made of thin films. By sandwiching the transparent thermoelectric module by a transparent plate at the top and a black plate at the bottom, the device is capable of harvesting radiative cooling and solar heat simultaneously in day and harvesting radiative cooling in night confirmed by outdoor and indoor measurements. Our device can be an efficient method to judiciously harvest solar heating and radiative cooling simultaneously, paving the way for efficient energy harvesters which can be used as stand-alone power supplies for off-grid sensor modules.

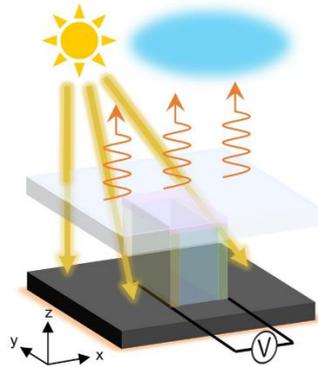


Fig. 1. Schematic of the device which has a solar-transparent radiative cooler at the top, a transparent thermoelectric module in the middle, and a blackbody-painted plate at the bottom.

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References

- [1] S. Ishii, T.D. Dao, T. Nagao, *Appl. Phys. Lett.* **117**, 013901 (2020).