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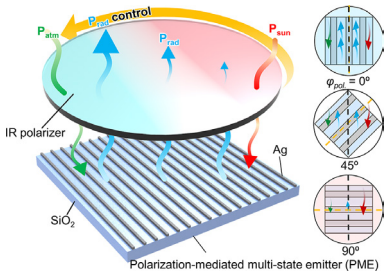
The zero-emission, energy free, and low-cost temperature regulation system can be continuously adjusted for precise heating and cooling.



As the climate changes, buildings must accommodate higher ambient temperatures. However, cooling systems often demand significant energy, possibly contributing to further pollution. Passive radiative cooling is an alternative to traditional air conditioning methods, pulling heat from the environment and sending it to space as infrared radiation. But because it constantly emits radiation, it is constantly cooling, even in the winter when higher temperatures inside are desired.

Dual-state emitters can switch the device on or off, but precise temperature control is necessary, especially in the spring or fall. To achieve high-precision temperature tuning in passive radiative cooling devices, Kim et al. designed an infrared polarized valve that continuously adjusts the emissivity.

“Our system consists of a vertically-arranged linearly polarized thermal emitter and an infrared polarizer,” said author Do Hyeon Kim. “The emitter only permits a linearly polarized thermal emission parallel to the silver grating direction. Thus, the emissivity of the polarization-mediated thermal emitter varies depending on the polarization angles.”

In testing, the device maintained a temperature within half a degree Celsius of the target value and significantly outperformed the single and dual-state emitters. The positive results were independent of varied ambient temperatures and the authors projected potential energy saving in different climates on a world map.

This is a promising step toward radiative cooling implementation, which would have wide-reaching energy-saving capabilities.

“Compared with conventional thermal regulation technologies, such as air conditioners and furnaces, radiative cooling has many advantages. It is compact, energy-free, low-cost, and zero-emission,” said Kim.

Continuous temperature regulation has applications in cooling large structures like office buildings and homes, but it can also be implemented in small electronic devices.

Source: “Polarization-mediated multi-state infrared system for fine temperature regulation,” by Do Hyeon Kim, Se-Yeon Heo, Yeon-Wha Oh, Sanghee Jung, Min Hyung Kang, Il-Suk Kang, Gil Ju Lee, and Young Min Song, *APL Photonics* (2023). The article can be accessed at https://doi.org/10.1063/5.0136842.