Electrocaloric Cooling With Electrostatic Actuation

Tech ID: 29763 / UC Case 2017-646-0

SUMMARY

A collaboration between researchers in the UCLA Department of Materials Science and Engineering and SRI International has developed a novel solid-state cooling system that allows for efficient heat transfer for small, mobile devices.

BACKGROUND

With the development of modern technologies, the need for efficient heat transfer and cooling systems to maintain stable temperatures has become increasingly necessary. The most common cooling systems consist of vapor-compression refrigeration systems which typically have a reported coefficient of performance (COP) of 2-4. However, the main disadvantages of these systems are that they are bulky and have circulating liquids/parts, which make them undesirable for small, mobile devices. To address these issues, there has been increased interest in developing efficient solid-state cooling systems, which are typically smaller, but are costlier and less efficient. Currently developed solid state cooling systems based on the Peltier effect, the conversion of temperature differences to voltage, report COPs that are much lower than the vapor-compression refrigeration systems. Improvements in the solid-state cooling systems are necessary to be applied to rapidly advancing technology.

INNOVATION

Dr. Pei and collaborators have developed a novel solid-state cooling system based on the electrocaloric (EC) effect, a reversible temperature change that occurs under an applied electric field, that employs an electrostatic actuator for effective thermal management. This system uses a flexible EC polymer stack and an electrostatic actuation mechanism to transfer heat. The researchers have demonstrated that this system can achieve a COP of 13, which is significantly higher than currently used vapor-compression refrigeration systems. Furthermore, this system can achieve a specific cooling power of 2.8 W/g, the highest reported value of any solid-state refrigeration to date.

APPLICATIONS

Thermal management of various electronic devices.

ADVANTAGES

- Higher COP compared to vapor-compression refrigeration systems
- Higher specific cooling power than current solid-state refrigeration systems to date
- Flexible, small size for nonconventional or mobile devices
- Lower cost compared to ceramic materials used in other solid-state cooling systems

STATE OF DEVELOPMENT

System developed and manuscript is in preparation for submission.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,397,031	07/26/2022	2017-646

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

Solid-state, cooling system, refrigeration, electrocaloric, heat, heat transfer, electrostatic actuation, thermal management, temperature control, polymer film, microfluidics

CATEGORIZED AS

- **Engineering**
  - Engineering
  - Other
- **Materials & Chemicals**
  - Other

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