

# **Two-Fold Reduction of Switching Current Density in Phase-Change Memory**

Researchers at Stanford have developed a low-power phase-change memory (PCM) technology with interfacial thermoelectric heating enhancement. This scalable innovation, with  $\sim 2x$  reduced reset power and reset current density, could be a promising route for high density data storage applications. While PCM technology has already been adopted in commercial products as a promising storage-class memory, high switching current density and switching power remain key challenges, including in emerging applications such as neuromorphic and in-memory computing. The Stanford technology leverages a substantial, positive thermoelectric coefficient in PCM materials to generate additional heating at an interface with another material, enabling memory switching with a large reduction in current and power. Interfacial thermoelectric engineering is applied to a PCM cell using a class of thermoelectric materials with negative thermoelectric coefficient (e.g., bismuth telluride,  $\text{Bi}_2\text{Te}_3$ ) to induce efficient heating at lower power and current. Other thermoelectric materials with large negative thermoelectric coefficient (e.g.,  $\text{PbTe}$ ,  $\text{La}_3\text{Te}_4$ ,  $\text{InSe}$ ,  $\text{Si}_{0.8}\text{Ge}_{0.2}$ ) could also be used instead, and these could be further optimized by changing their composition, deposition, and thickness.

## **Stage of Development**

The researchers have demonstrated their PCM technology leverages thermoelectric heating at the PCM interface to provide a  $\sim 2x$  reduction in the reset current density and power at a similar voltage.

## **Applications**

- High density data storage

## Advantages

- Reduction of switching current density and switching power is a critical problem facing the industry
- Innovative yet simple and scalable
- ~2x less power and reset current density compared to control PCM devices
- Enhanced thermoelectric heating with reduced reset power

## Publications

- Khan, Asir Intisar, et al. "[Two-Fold Reduction of Switching Current Density in Phase Change Memory Using Bi<sub>2</sub>Te<sub>3</sub> Thermoelectric Interfacial Layer.](#)" *IEEE Electron Device Letters* 41.11 (2020): 1657-1660.

## Patents

- Published Application: [20220115590](#)

## Innovators

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