Novel Chalcogenide Superlattice-Based Energy-Efficient Phase-Change Memory for 3D Heterogeneous Integration

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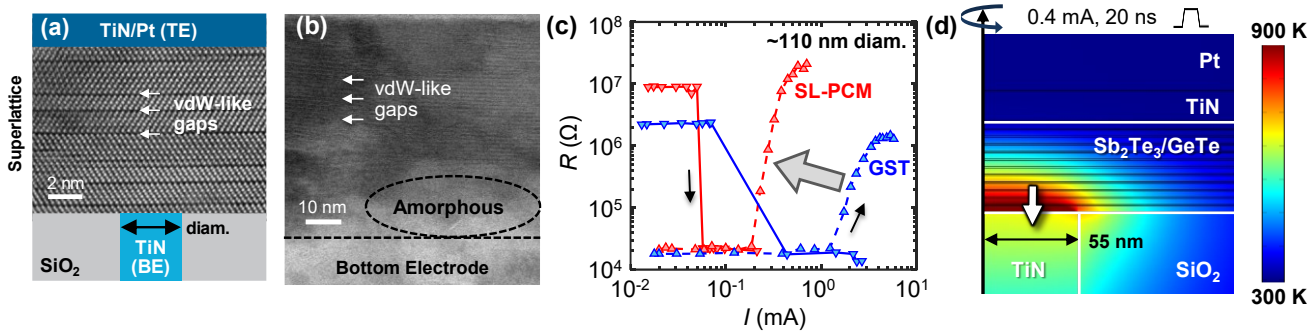

Fig. 1: Superlattice Phase-Change Memory (PCM) [1]. **(a)** Schematic of superlattice (SL) PCM device with alternating thin chalcogenide layers having van der Waals-like interfaces. **(b)** High-resolution scanning transmission microscope (STEM) cross-section of an SL-PCM device in the high resistance state. **(c)** Resistance (*R*) vs. current (*I*) in SL-PCM vs. control GST PCM showing ~10x reduction in switching current for SL-PCM. **(d)** Electro-thermal simulation showing strong heat confinement in SL-PCM.

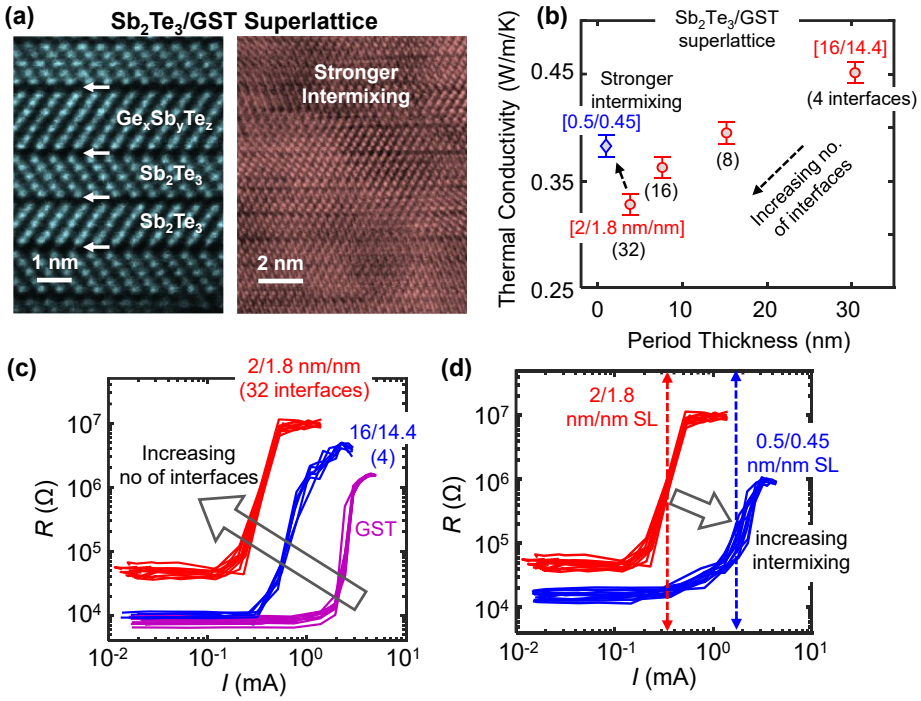

Fig. 2: Superlattice (SL) Materials-Device Correlation [2]. **(a)** STEM images of SLs comparing good quality vs. intermixed SL. **(b)** Interface controlled cross-plane thermal conductivity in Sb_2Te_3/GST superlattice. Measured *R* vs. *I* in SL-PCM showing **(c)** reduction of switching current with increasing SL interfaces, and **(d)** increase in the switching current due to intermixing within the SL interfaces. Here, the bottom electrode diameter ~110 nm.

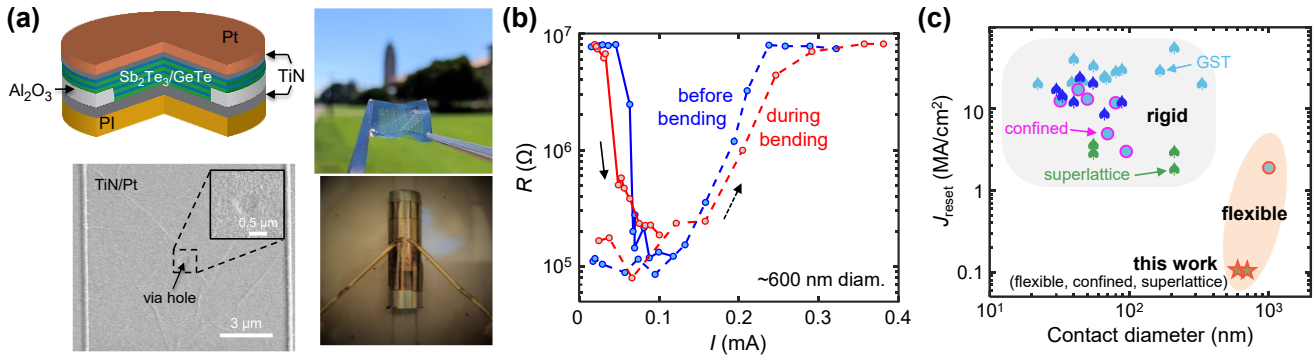

Fig. 3: Flexible Superlattice Phase-Change Memory [3]. **(a)** Schematic, scanning electron microscope and photographs of our superlattice PCM on flexible polyimide (PI) substrate. **(b)** Resistance (*R*) vs. current (*I*) in flexible SL-PCM with 600 nm bottom electrode diameter showing low switching current both before and during bending. **(c)** Record-low switching current-density in flexible superlattice PCM compared to existing demonstrations of PCM technology.

References:

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