Room-temperature memristive switching between charge density wave states

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Control over the novel quantum states that emerge under non-equilibrium conditions is of both fundamental and technological importance. Metastable charge density wave (CDW) states are particularly interesting as their electrical manipulation could lead to ultra-efficient memory devices. However, using electrical pulses for non-volatile resistance switching involving CDW states has been limited to cryogenic temperatures [1]. We investigate a recently discovered layered semiconductor $EuTe_4$, which exhibits the coexistence of distinct CDW orders [2,3]. We report that electrical pulses can be used for excitation to non-equilibrium, yet stable electronic states across a broad temperature range from 6 K to 400 K [4]. We find that switching occurs through a non-thermal pathway and is reversible via a thermal erase procedure. The resistance of the new electronic state is tunable by the pulse voltage, so the device acts as a memristor. Our calculations suggest that switching leverages a bistability in the stacking of CDW order in Te layers, which are separated by the weak Eu-Te link. Low-voltage, fast, and energy-efficient CDW switching holds great promise for memristor applications.

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