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Discovery of a New Memory switching Mechanism in Phase-Change Nanowires ELHAM MAFI, Washington State University — In phase-change memory, the structure-property relation is critical to understanding and controlling the memory switching process. Here we correlate the local electrical and structural properties of phase-change In_2Se_3 nanowires, by performing high-resolution transmission electron microscopy and scanning Kelvin probe microscopy on the same nanowires. This approach reveals a direct correlation between a presence of dislocations and a high local electrical resistance in nanowires subject to the RESET switching (i.e. switching from low to high electrical resistance state). This correlation indicates that the RESET switching, commonly understood as the amorphization process, can occur entirely via the generation of dislocations at temperatures much below the melting point. From a fundamental perspective, this discovery provides new insight into the critical structure-property relation in phase-change materials and the important role of dislocations. Practically, since the RESET switching is commonly considered as the most energy-consuming process that requires heating above the melting point, our findings suggest that a more energy-efficient phase-change memory can be realized based on In_2Se_3.

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