

Femtosecond laser pulse induced switching of GeTe-Sb₂Te₃ multilayered thin films

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Phase change materials (PCM) thin films offer great potential for the use in key enabling technologies such as neuromorphic computing, thereby driving the boost of artificial intelligence. These applications are based on the reversible switching of the optical and electronic properties of PCM, which is caused by a change in structure and can be triggered by optical or electrical pulses. Tailored physical behavior alongside improved switching characteristics were shown to be achievable by alternately stacking of two different PCM [1–3]. However, the clarification of the underlying causes and particularly the switching mechanism of these multilayers (ML) are the aim of current research.

Here, 30 nm GeTe-Sb₂Te₃-MLs were investigated. Thin film growth was performed by pulsed laser deposition as this method allows precise control of the layer thickness [4]. The samples were switched by an IR fs laser. For the measurement of the switching time, an optical pump-probe setup was employed. Due to the usage of a streak camera, 85 ps time resolution was reached. Additionally, the evolution of the surface morphology and microstructure of the MLs were analyzed by light microscopy, SEM and TEM. Overall, the combination of the employed experimental setup with the detailed analysis represents a distinctive approach for the investigation of PCM switching. Thereby, additional to technologically relevant parameters like the threshold values for laser fluence and pulse number, the results contribute to the fundamental understanding of the switching of PCM-MLs. Beyond that, several opportunities for future work in multiple directions are identified.

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[2] Shportko K., Cremer S., & Lotnyk A. (2025). Thickness-dependent optical and structural properties of chalcogenide phase-change memory thin films grown at room temperature by pulsed laser deposition. *Applied Physics Letters*, 127(20).

[3] Feng J., Lotnyk A., Bryja H., Wang X., Xu M., Lin Q., Cheng X., Xu M., Tong H. & Miao X. (2020). “Stickier”-surface Sb₂Te₃ templates enable fast memory switching of phase change material GeSb₂Te₄ with growth-dominated crystallization. *ACS applied materials & interfaces*, 12(29), 33397-33407.

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