INTERFACIAL PHASE-CHANGE MATERIALS WITH IMPROVED STABILITY: A COMPARISON OF $Ge_{45}Te_{52}S_3/Sb_2Te_3$ WITH $GeTe/Sb_2Te_3$ SUPERLATTICES

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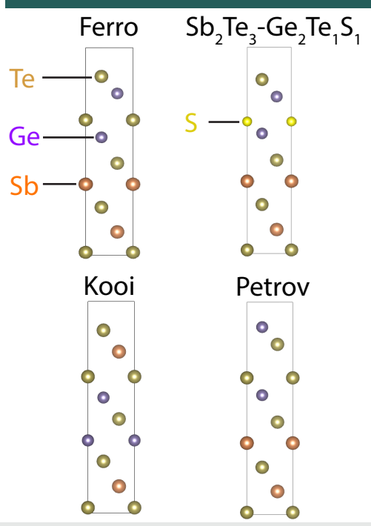
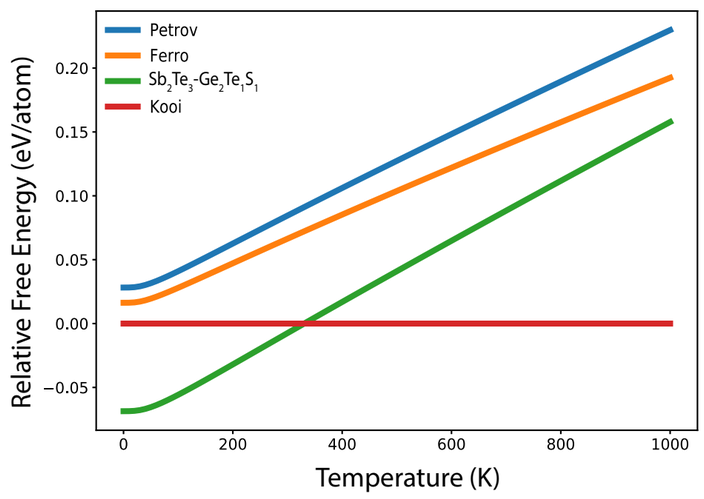
INTRODUCTION

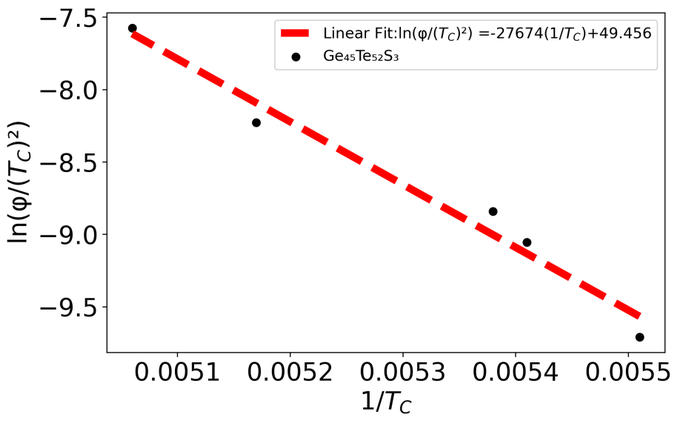
- Interfacial phase-change memory (iPCM) [1] superlattices improve performance of PCRAM.
- Switching energy for superlattices is reduced by confining the phase transition to 2D to minimise entropic losses.
- However, interlayer atomic mixing has been reported in such superlattices.
- Sulphur(S)-doping might improve stability [2].
- To study the effect of sulphur(S)-doping on the stability and switching speeds of GeTe and $Ge_{45}Te_{52}S_3/Sb_2Te_3$ superlattices.

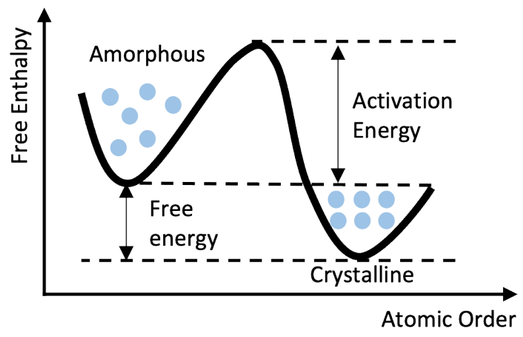
FREE ENERGY CALCULATIONS



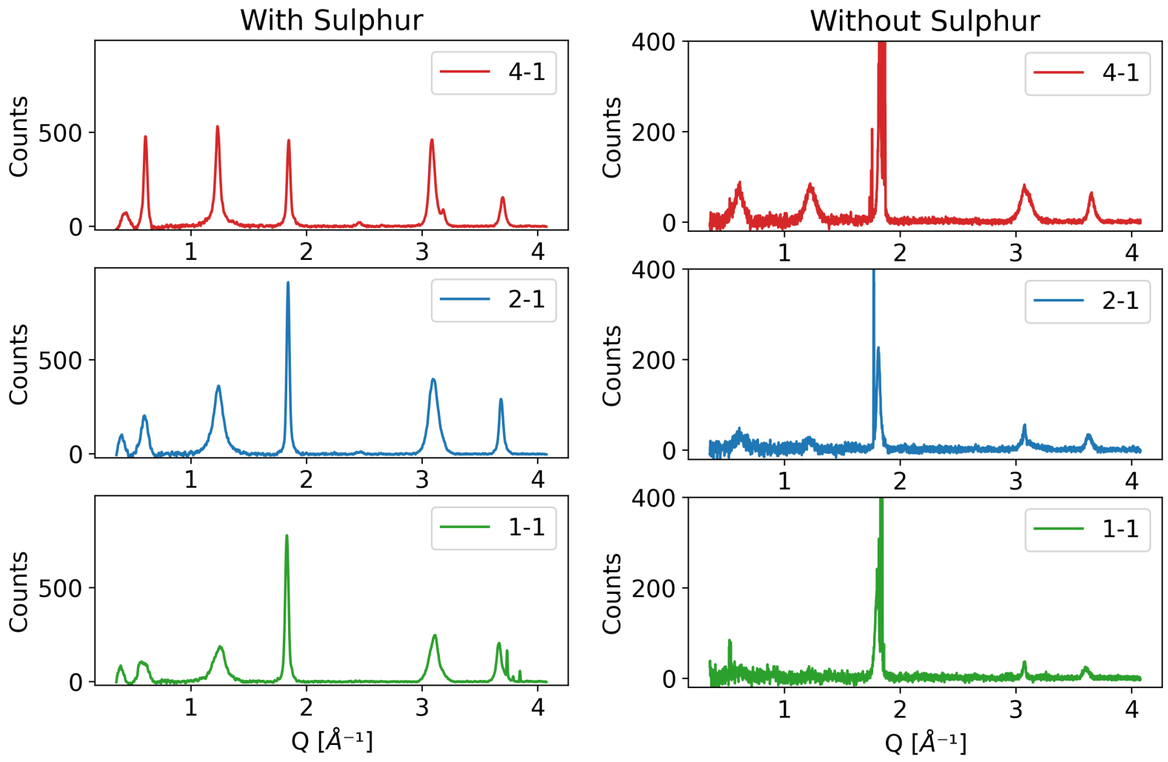


IMPROVED STABILITY WITH SULPHUR DOPING

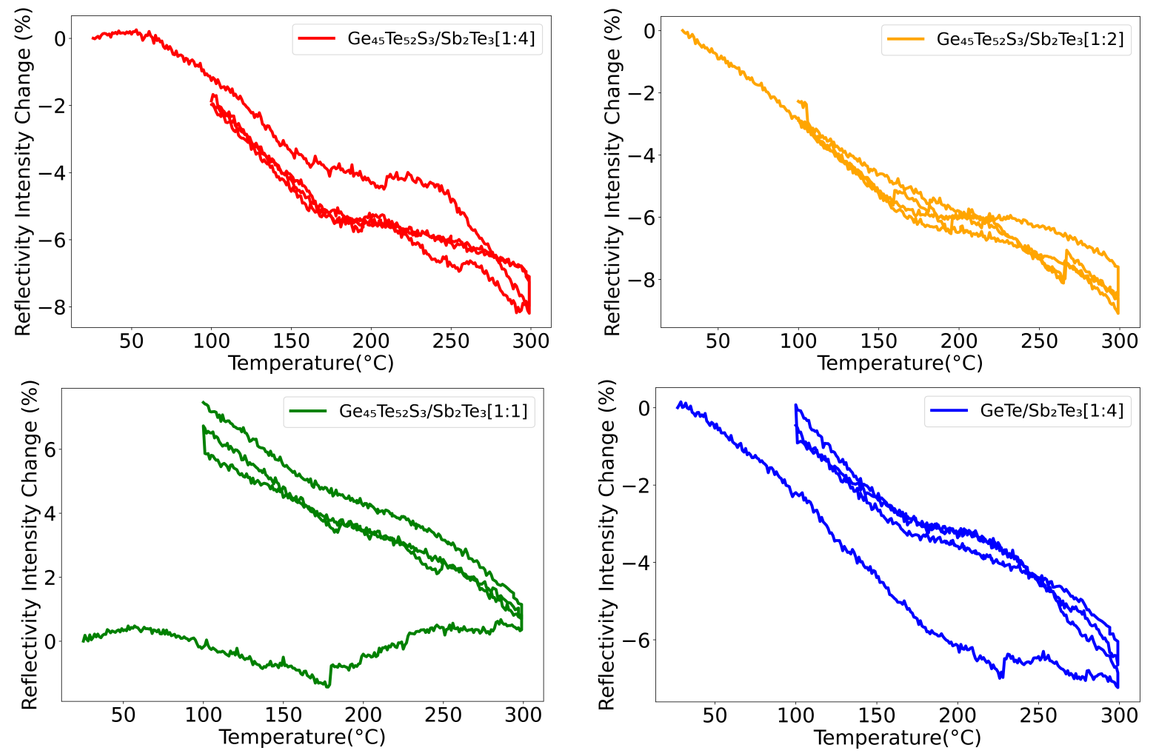




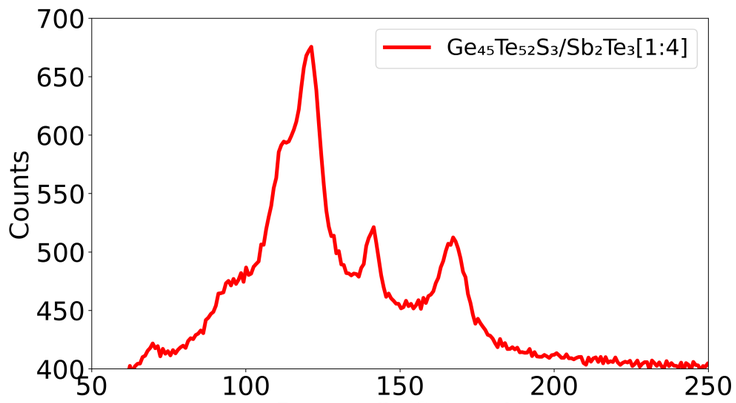
- Kissinger Analysis Graph for $Ge_{45}Te_{52}S_3$.
- $Ge_{45}Te_{52}S_3$ has a higher activation energy of 2.39eV than pure GeTe which was found to be at 2.31eV [3] which indicates higher thermal stability.



- XRD plots for $Ge_{45}Te_{52}S_3/Sb_2Te_3$ and $GeTe/Sb_2Te_3$ superlattice.
- S-doping decreases the lattice spacing and increases ordering of layers.

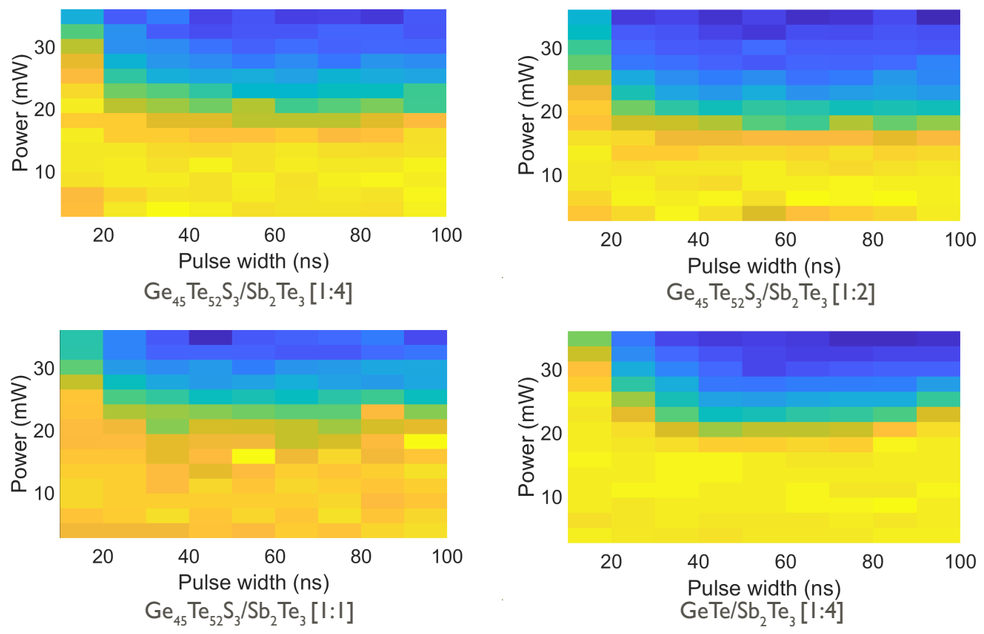


- Optical Reflectivity vs Temperature heating cycle curves for superlattices.
- $Ge_{45}Te_{52}S_3/Sb_2Te_3$[1:4] superlattice has higher stability during heating.



- Raman Spectrum of $Ge_{45}Te_{52}S_3/Sb_2Te_3$ [1:4] superlattice.

SWITCHING MEASUREMENTS



CONCLUSIONS

- $Ge_{45}Te_{52}S_3/Sb_2Te_3$ superlattice provides a solution to the intermixing problem and allows high speed phase change data storage switching with low power heat pulses.

REFERENCES

[1] R. E. Simpson et al., "Interfacial phase-change memory," Nat. Nanotechnol., vol. 6, no. 8, pp. 501–505, 2011, doi: 10.1038/nnano.2011.96.
[2] J. Tominaga, S. Sumi, and H. Awano, "Intermixing suppression through the interface in $GeTe/Sb_2Te_3$ superlattice," Appl. Phys. Express, vol. 13, no. 7, 2020, doi: 10.35848/1882-0786/ab9710.
[3] X. Zhou, W. Dong, H. Zhang, and R. E. Simpson, "A zero density change phase change memory material: GeTe-O structural characteristics upon crystallisation," Sci. Rep., vol. 5, no. May, pp. 1–8, 2015, doi: 10.1038/srep11150.

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