Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Wednesday, June 10th 2015 - 15:00
CFEL Seminar Room III, EG-080, (Bldg. 99)

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Phase Change Materials and how they crystallize

Phase change materials (PCM) display a variety of unique physical properties that allow for the application as data storage. PCMs are readily employed in rewritable DVDs and Blu-RayTM discs and novel solid state memories are currently being developed [1].

All storage devices utilize the pronounced contrast in physical properties of the amorphous and crystalline phase of this material class, which originates from the different chemical bonding of *a*- and *c*-phase. Crystalline PCMs feature a bonding mechanism with resonant character which is responsible for the pronounced change in optical properties upon crystallization [2][3]. The functionality as a storage device requires rapid switching between two. PCMs crystallize at speeds comparable to the velocity of sound making them a formidable storage material. Thus the fast crystallization velocity renders its determination difficult in common experiments relying on diffusive heat transport [4].

I present a (novel) technique to determine crystal growth velocities of amorphous thin films over a wide temperature range. It is based on the repetitive excitation of the glassy phase with femtosecond optical pulses and probing the transient optical reflectivity. Due to the fast cooling rate, this techniques allows reaching the supercooled liquid state up to the melting point of the corresponding crystalline phase. For the phase-change material $Ag_4In_3Sb_{67}Te_{26}$ (AIST) we obtain a maximum crystal growth velocity of more than 100 m/s. Furthermore the data allowed to extract information about the glass transition temperature and the kinetic fragility.

1 S. Raoux, (2009) Annu. Rev. Mater. Res., 39:25–48
2 Shportko, K., Kremers, S., Woda, M., Lencer, D., Robertson, J., & Wuttig, M. (2008), *Nature Materials*, *7*(8), 653–8.
3 Huang, B., & Robertson, J. (2010), *Physical Review B - Condensed Matter and Materials Physics*, *81*(8), 1–4.
4 Salinga, M et al. (2013), *Nature Communications*, *4*, 2371

Host: Andrea Cavalleri

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