Crystal growth front instabilities in Ge doped Sb films

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ABSTRACT

Our study focusses on the crystallization kinetics of fast-growing Sb-rich GeSb films. The crystal growth in these films was studied using a high speed optical camera. Films of 200 nm Ge_7Sb_{93} and Ge_9Sb_{91} were deposited on poorly heat-conducting glass or polycarbonate substrates and capped with a 5nm SiO-ZnS layer. During nucleation and crystallization interesting crystal growth front instabilities were observed in these samples. The crystallization fronts of Ge_7Sb_{93} become unstable when the sample is heated above the glass transition temperature T_g of polycarbonate substrate. The crystal shape changes from a triangular shape into a star-shaped crystal with typically 6 tips which can each split in to 2 or 3 new tips. Additionally we see wrinkling of the film caused by the softening of the substrate creating a stress field parallel to the tip in the amorphous material, promoting crystal growth parallel to the stress field. After crystallization, wrinkles are formed in the crystalline tip perpendicular to the growth direction of the tip. Furthermore, in Ge_9Sb_{91} films on glass substrates two competing crystal growth modes were observed in the temperature range of 181 ^oC to 187 ^oC. Below 181 ^oC isotropic growth is favored, above 187 ^oC much faster dendritic growth is favored. Between 181 ^oC and 187 ^oC the crystal growth is initially isotropic but after certain incubation time some crystals start to grow dendritic and overtake the slower growing isotropic crystals. Finally the huge effect of stresses in the phase-change film on the crystal growth is unequivocally demonstrated by changing the 2-dimensional crystal growth into 1-dimensional growth by applying compressive bending stresses.