Characterization of Low Temperature Crystallization Growth of the Phase Change Materials: $Ge_1Sb_6Te_1$ and $Ga_{15}Sb_{85}$

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Abstract

Phase change memory materials are a set of chalcogenide or pnictogenide materials systems currently being researched for use in optical and resistive based memory systems due to their large change in optoelectronic properties between the amorphous and the crystalline states. For these materials systems to be considered as a suitable candidate for memory applications it is imperative that crystal growth characteristics are understood across a range of temperatures. It is necessary for these materials to have low crystallization rates at lower temperatures so that the written memory remains stable for a prolonged period of time. In this work, the low temperature crystal growth rate and Johnson Mehl Avrami Kolmogorov analysis parameters of two growth dominated phase change material systems, $GeSb_6Te$ and $Ga_{15}Sb_{85}$, were calculated using in-situ hot stage optical microscopy. $GeSb_6Te$ was isothermally crystallized at temperatures from 185°C to 195°C and $Ga_{15}Sb_{85}$ was isothermally crystallized at temperatures 170°C to 180°C. Images were taken and the growth of individual grains was measured as well as the percent of material crystallized. These materials were found to have comparable growth and crystallization rates in the low temperature region as other typical nucleation dominated materials such as AIST and GeTe. The measurements done in this work are part of a broader goal to characterize the crystallization kinetics of phase change materials systems over the entire range of temperatures where crystallization occurs.

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