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Explosive Crystallization of Amorphous Semiconductor Films in the Presence of Melting ALEXANDER GOLOVIN, Northwestern University, COSTAS GRIGOROPOULOS, MATTHEW ROGERS, SEUNG HWAN KO, University of California Berkeley, BERNARD MATKOWSKY, Northwestern University — Explosive crystallization (EC) of thin amorphous solid films of germanium is investigated theoretically and experimentally. EC regime characterized by a propagating melting layer between the amorphous and the crystalline phases is considered. Laser-induced, linear EC fronts, uniformly propagating over large distances are achieved in films with various thicknesses deposited on quartz substrate. Depending on the front speed, the film thickness and the substrate temperature, different types of morphology of the resulting crystal phase are observed: columnar, scalloped and mixed. A theory of EC in the presence of melting is developed. The EC front propagation speed is calculated as a function of the substrate temperature and the film thickness; it is found to be in a good agreement with experiments. Linear stability analysis of a uniformly propagating planar EC front is performed. It is shown that for the parameter values where the columnar crystalline structure was observed the front is unstable with respect to a fingering instability similar to the Mullins-Sekerka instability of a solidification front in an undercooled melt. Nonlinear evolution of this instability is simulated numerically and is shown to exhibit a structure similar to the columnar one.

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