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Modeling and Experimental Verification of Crystal Growth Kinetics in Glass Forming Alloys

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Abstract : We analyze the structure of undercooled melts, crystal growth kinetics and amorphous/crystalline microstructure of rapidly solidifying glass-forming Pd-based and CuZr-based alloys. A dendrite growth model is developed using a combination of the kinetic phase-field model and mesoscopic sharp interface model. The model predicts features of crystallization kinetics in alloys from thermodynamically controlled growth (governed by the Gibbs free energy change on solidification) to the kinetically limited regime (governed by atomic attachment-detachment processes at the solid/liquid interface). Comparing critical undercoolings observed in the crystallization kinetics with experimental data on melt viscosity, atomistic simulation's data on liquid microstructure and theoretically predicted dendrite growth velocity allows us to conclude that the dendrite growth kinetics strongly depends on the cluster structure changes of the melt. The obtained data of theoretical and experimental investigations are used for interpretation of microstructure of samples processed in electro-magnetic levitator on board International Space Station in the frame of the project "MULTIPHAS" (European Space Agency and German Aerospace Center, 50WM1941) and "KINETIKA" (ROSKOSMOS).

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