HOT CRYSTALLIZATION CENTERS IN GAS-SATURATED LAYERS OF AMORPHOUS ICE

Faizullin M.Z.,* Vinogradov A.V., Tomin A.S., Koverda V.P.

ITP of UB of RAS, Ekaterinburg, Russia
**faizullin@itp.uran.ru*

A distinctive feature of crystallization at intensive nucleation in amorphous solids is the possibility of spontaneous emergence of "hot" centers and explosive crystallization in places of local accumulation of fluctuation arising embryonic crystals. The condition for the emergence of "hot" centers and a spontaneous transition to an explosive crystallization regime in an amorphous medium with frozen crystals requires their locally high concentration, which can be achieved both as a result of the natural nucleation process and external influence at a nonequilibrium system.

In a series of experiments, the possibility of initiating explosive crystallization in layers of amorphous ice saturated with methane in the presence of artificially introduced embryonic crystals is shown. Nonequilibrium amorphous condensates were obtained by supersonic deposition of molecular beams of rarefied vapor and gas on a liquid nitrogen cooled substrate. Adiabatic expansion of the molecular steam flow at the outlet of the supersonic nozzle led to a decrease in temperature and the formation of crystal clusters of ice in the molecular flow. The presence of the crystal centers in the sample shifted the beginning of crystallization to the low temperature region, and the form of the thermal signal, consisting of several peaks, testified to crystallization from different centers.

The initiated explosive crystallization of gas-saturated layers of amorphous ice was also investigated by the influence of local thermal heating at temperatures below the temperature of spontaneous crystallization of the sample. Heating was carried out by a short-term thermal pulse using a wire electric probe or laser beam.

Crystallization of water-gas layers under deep metastable conditions leads to formation of gas hydrate. The avalanche-type initiation of crystallization centers captures gas molecules and does not lead to their displacement by the crystallization front.

The work was supported by the Russian Foundation for Basic Research (Grants No 18-08-00352-a, No 18-38-00443 mol-a) and the Program for Basic Research of the Ural Branch of the RAS (Grant No 18-2-2-3).