Self-organized dynamic ultradisperse structures on the interface in two-dimensional open system with first-order phase transition.

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The phenomenon of periodic crystallization and melting of the surface layer of a system in isothermal conditions at a temperature close to the phase transition temperature is studied.
The system is a dilute solution of a volatile admixture (NH_3 or C_2H_5OH) in water and consists of microspheres of the solid phase of the solvent (H_2O) distributed in the surface layer of the solution; they aggregate with each other and form a two-dimensional disperse system.
The dimensions of the nuclei of the solid phase during their evolution vary from 0.1 to 10 microns.
The system is open: the admixture diffuses into the system from the reservoir and evaporates from the surface. In a known range of parameters and boundary conditions, dissipative structures arise in the system, as well as autowaves of structural rearrangement.
It is established that the solidification wave front is a traveling fractal cluster, the melting wave is also scale-invariant.
The variety of dynamic regimes of the system is caused by the presence of metastable states under the cooperative interaction of its elements and the influence of surface effects.
Mathematical models of the phenomenon are proposed, investigated and discussed.
There is every reason to believe that such phenomena can be detected in ultradispersed systems at both micro- and nano-scales.

References

[1] Buravtsev V.N., Botin A.S., Malomed B.A. The Autowave Phenomena on the Surface of Crystallizing Solution. In: Self-Organization, Autowaves and Structures Far from Equilibrium (Editor: V.I.Krinsky), Springer-Verlag, Berlin-Eidelberg-N.Y.-Tokyo, 1984, pp.59-63.

Figures

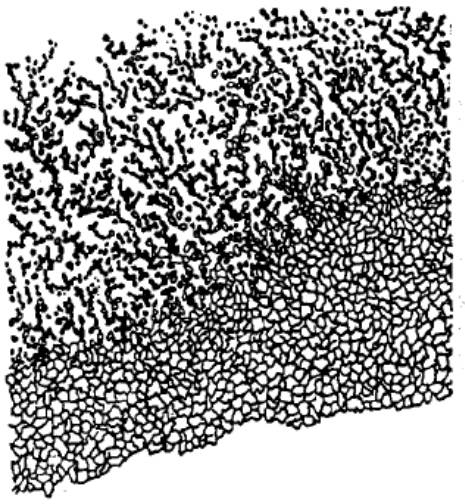

Figure 1: The solidification wave front is a traveling fractal cluster of aggregated microspheres of the solid phase of the solvent (H_2O) distributed in the surface layer of the solution. The dimensions of the nuclei of the solid phase during their evolution vary from 0.1 to 10 microns. The motion of the crystallization front is directed from the bottom to the top.