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Guskov Aleksandr

Institute of Solid State Physics-RAS, Russia

The formation of periodic concentration distribution under the phase transition of solutions

The purpose of this study is to explain how the periodic alternation of phases is formed in a homogeneous liquid solution during phase transition liquid-solid. The formation of a periodic structure is explained for two cases; first, for the case where the periodic distribution of the components occur in the liquid phase and second, the formation of periodic eutectic structure. This study shows that a solution during crystallization can be in unstable state. The unstable condition leads to decomposition the solution by spinodal scenario. Experimental demonstration of spinodal decomposition of the solution is conducted by video shooting process of decomposition of an aqueous solution of bromothymol blue while its crystallization. Periodic distribution bromothymol blue is the result of these experiments. Locally configuration thermodynamic model is used to explain the state changes of the solution during the phase transition. Spinodal decomposition of the solution explains the process of formation of a periodic distribution of the eutectic composites. The layer of the unstable solution is localized in front of the unstable interface. The unstable solution decomposes into phases, which have a composition close to the eutectic composition of the solid phases. The period of alternation of these phases is set by the period of instability of the interface. Experiments show that the formation of dendrites in the mushy zone and extremum of the component concentration during steady-state regime of crystallization close to interface also occurs in the spinodal decomposition scenario.

Recent Publications

1. A Guskov and L Nekrasova (2013) Decomposition of solutions in front of the interface induced by directional crystallization. Journal of Crystallization Process and Technology 3:170-174.
2. Guskov A P, Nekrasova L P, Ershov A E and Kogtenkova O A (2013) The decomposition of the solution in the interface under directional solidification. Materials Science, 10:10-15.
3. Guskov A () Spinodal decomposition of solution during crystallization. Diffusion Fundamentals 30:1-9.
4. Guskov A P (2016) The decomposition of the solution during the formation of eutectic composites. COMPOSITES and NANOSTRUCTURES, 8 (3): 2-15.
5. Alex Guskov (2014) On linear analysis of the movement of the interface under directed crystallization. Advances in Chemical Engineering and Science 4:103-119.

Biography

Guskov Aleksandr has completed his PhD at Physical Institute of the Russian Academy of Sciences in 1982. Then he went to work at the Institute of Solid State Physics the Russian Academy of Sciences, investigated the influence of interaction of laser radiation and a solid. Simultaneously, he was engaged in application of technological processes in manufacture of electronic devices. Now his research interest focuses on Heat Mass Transfer during the phase transition.

guskov@issp.ac.ru