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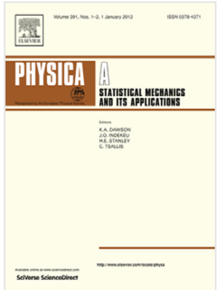

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SPECIFIC MASS INCREMENT AND NONEQUILIBRIUM CRYSTAL GROWTH

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Abstract

Unsteady nonequilibrium crystallization of ammonium chloride from an aqueous solution resulting in the formation of irregular, so-called seaweed, structures is experimentally investigated. It is shown that specific increment of mass for the coexisting structures (or parts thereof) is the same and changes with time (t) according to the power law $a/t - b$, where the factor $a = 1.87 \pm 0.09$ and the factor b is determined by the system relaxation time. The normalization of the power law to the total time of structure growth allows obtaining a universal law that describes the specific mass increment with time for both seaweed and dendrite structures (including the non-coexisting ones).

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Keywords: Nonequilibrium crystallizaiton; Specific mass increment; Growth curves; Dendrite; Seaweed.

1. Introduction

If nuclei of a new crystalline phase originate in a sufficiently supersaturated solution/vapor (or a supercooled melt), then eventually, during the relaxation of the system to the equilibrium, they will grow into different nonequilibrium structures: dendrites, nonsymmetrical diffusion-limited aggregates (DLA), seaweed structures, etc. [1-6]. This phenomenon is very common both in nature (for example, during the formation of snow crystals in clouds) and in industry (specifically in metallurgy, in the case of steel production). As a consequence, this phenomenon has been comprehensively studied in the scientific literature for at least the last fifty years [7-12]. It is well known that the nonequilibrium growing structures are extremely inhomogeneous, specifically they consist of crystal tree-like branches which have various sizes and growth rates. Additionally, in the case of such growth, the coexistence of principally different structures (for example, regular and irregular dendrites) is also possible [5, 6]. The above phenomena are observed even if the degree of nonequilibrium during crystallization is maintained artificially. If crystallization is considered subject to the reduction of the degree of nonequilibrium in the medium caused by the free crystal growth (the most natural and common

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