ТЕЗИСЫ ДОКЛАДОВ

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Перспективные материалы с иерархической структурой для новых технологий и надежных конструкций»

X МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Химия нефти и газа»

Томск

Издательский Дом ТГУ

2018

DOI: 10.17223/9785946217408/134

COMPUTER-AIDED DESIGN OF 3D MICROSTRUCTURES PRODUCED BY ADDITIVE MANUFACTURING

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The microstructure-based modeling of material constitutive behavior is especially important in mechanics. The prediction of the material deformation behavior using microstructure-based material models is particularly topical for innovative production technologies such as additive manufacturing (AM) where parts of complex geometries are manufactured. A specific microstructure formed during additive manufacturing may lead to the anisotropy of the mechanical properties and, thus, affects the mechanical behavior of the AM part. In this regard, it is important to develop the microstructural constitutive models of AM materials which mechanical behavior will be further investigated numerically.

In this paper two approaches to simulating AM microstructures are presented. First approach relies on the mathematical description of the microstructure evolution during AM process, taking into account complex thermal and physical processes involved. The numerical solution is based on a combination of the finite difference method for modeling AM thermal processes and the cellular automata method for describing the grain growth. The other approach provides fast generation of artificial 3D microstructures similar to those produced by AM by the grain geometrical characteristics, using the step-by-step packing method.

This work is supported by the Deutsche Forschungsgemeinschaft (Grant No. PL 584/4-1) and the Russian Foundation for Basic Research (Grant No. 18-501-12020).