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Co-Chairs: Qingyou Han, Purdue University; Lin Liu, Northwestern Polytechnical University; Dongke Sun, Shanghai Jiao Tong University; Shuanglin Chen, CompuTherm

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Modeling and simulation of influence of solidification velocity on the structure of lotus-type porous metals

Liu Yuan; Yang Qianqian; Li Yanxiang, Tsinghua University

ABSTRACT

A three-dimensional time-dependent model describing the evolution of single pore during the solid/gas eutectic unidirectional solidification process (also called *gasar* process) was established. The mass transfer, bubble nucleation, pore growth, and interruption were all considered in this model. The pore structure of lotus-type porous copper and aluminum was simulated under different solidification velocities. The results indicate that coupled growth of both solid and gas phases can be achieved in a proper range of solidification velocities. The solidification velocity for Cu–H_2 system is dozens of that for Al–H_2 system when the pore diameter is similar to each other. The differences of the solute distribution coefficient (k_0), diffusion coefficient (D_L), and the constant of solubility of hydrogen [$x(T_m)$] in the melt are regarded as the main reasons of the big discrepancy of solidification velocity between Cu–H_2 and Al–H_2 systems.

KEYWORDS: solid/gas eutectic, unidirectional solidification, lotus-type porous, solidification velocity, modeling and simulation