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Three mechanisms responsible for pore formation in solids

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Porosity in solids influences not only microstructure of materials, but also contemporary issues of biology, engineering, foods, geophysics and climate change, etc. In this work, the realistic pore shape is determined by accounting for mass and momentum transport of solute across a self-consistent shape of the cap, as proposed previously. It is found that there exist three mechanisms for pore formation, governed by a dimensionless parameter representing the difference in pore volume expansion and solute transfer across the bubble cap. Case 1 is subject to solute transport from the pore into surrounding liquid as a result of the cap emerged from a thin concentration boundary layer on the solidification front in the early stage. Bubble entrapment takes place in this case. Opposite directions of solute transport across the cap submerged into a thick concentration boundary layer along the solidification front, however, cannot result in bubble entrapment, because solute increases and decreases rapidly in late stage in cases 2 and 3, respectively. The predicted pore shape in solid agrees with experimental data. Numerical computations of development of the pore shape associated with transport processes of fluid flow, temperature and concentration are also presented.

Biography

Wei Peng-Sheng has received his PhD in Mechanical Engineering Department at University of California, Davis, in 1984. He has been a Professor in the Department of Mechanical and Electro-Mechanical Engineering of National Sun Yat-Sen University, Taiwan, since 1989. He has contributed to application of heat transfer in manufacturing and materials processing, and atmospheric phenomena. He has published more than 85 journal papers, given keynote or invited speeches in international conferences more than 100 times. He is a Fellow of AWS (2007), and a Fellow of ASME (2000). He also received the outstanding Research Achievement Awards from both the National Science Council (2004), and NSYSU (1991, 2001 and 2004), the outstanding Scholar Research Project Winner Award from National Science Council (2008), the Adams Memorial Membership Award from AWS (2008), the Warren F Savage Memorial Award from AWS (2012), and the William Irrgang Memorial Award from AWS (2014). He has been the Xi-Wan Chair Professor of NSYSU since 2009, and invited distinguished Professor in the Beijing University of Technology, China.

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