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The effects of interfacial properties on pore shape during solidification

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Pore formation and its shape in solid influence not only microstructure of materials, but also contemporary issues of various sciences of biology, engineering, foods, geophysics and climate change, etc. In order to remove and control porosity, understanding its formation is important. A pore formed in solid is a consequence of a bubble nucleated by super-saturation and entrapped by a solidification front. This work accounts for realistic mass and momentum transport across a self-consistently and analytically determined shape of the bubble cap, whose surface is in physico-chemical equilibrium beyond the solidification front. Accurate determination of contact angle from a realistic shape of the cap is required to predict the relevant shape of the pore in solid. It was systematically found that there are two different solute transport models subject to thin and thick thicknesses of concentration boundary layers on the solidification front. Case 1 accounts for species transport from the pore across an emerged cap through a thin concentration boundary layer on the solidification front into surrounding liquid in the early stage, whereas Case 2 is subject to species transport from the surrounding liquid across a submerged cap within a thick concentration boundary layer into the pore. The results find increases in interfacial properties such as Henry's law constant and Bond number decrease the pore radius. The predicted pore shape agrees with experimental data. A realistic prediction and control of the growth of the pore shape has therefore been obtained.

Biography

Peng-Sheng Wei 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, Kaohsiung, Taiwan, since 1989. He has contributed to advancing the understanding of and to the applications of electron and laser beam, plasma, and resistance welding through theoretical analyses coupled with verification experiments. Investigations also include studies of their thermal and fluid flow processes, and formations of the defects such as humping, rippling, spiking and porosity. He has published more than 80 journal papers, given keynote or invited speeches in international conferences more than 90 times. He is a Fellow of AWS (2007), and a Fellow of ASME (2000). He also received the Outstanding Research Achievement Awards from both 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, during 2015-2017.

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