Scaling of Thermocapillary Molten Pool Shape during Laser Melting

Peng-Sheng Wei, National Sun Yat-Sen University,
Kaohsiung, Taiwan

Abstract (300 word limit)

The molten pool or fusion zone shape and transport variables affected by thermocapillary force during melting or welding with a distributed energy beam can be scaled as functions of specified working variables. pool. The scaling analysis considers different thicknesses of thermal and momentum boundary layers in different regions in the molten pool. Incident flux is irradiated in the central region of the free surface. The driving force is thermocapillary force balanced by shear stresses in the shear layer below the free surface. The scaling results are found to agree well with experimental data and numerical computations for different Prandtl numbers, as shown in Figure 1. Figures 2 and 3 show that scale analysis of the fusion zone depth and width agree well with numerical computations.

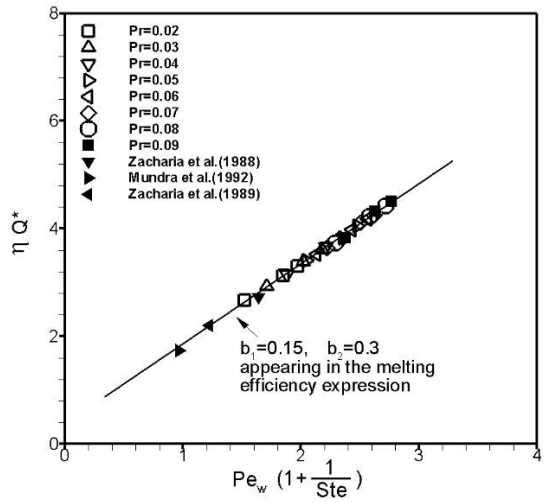


Figure 1 comparison between scale analysis, numerical computation and experimental data for different Prandtl numbers

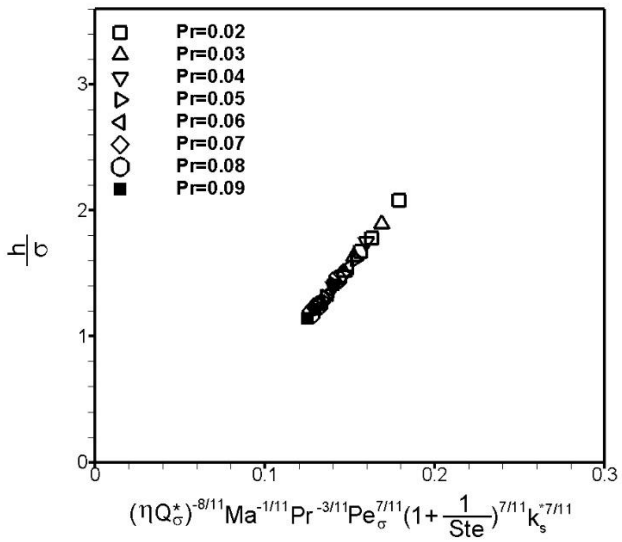


Figure 2 Comparison between scale analysis and numerical computation of fusion depth for different Prandtl numbers

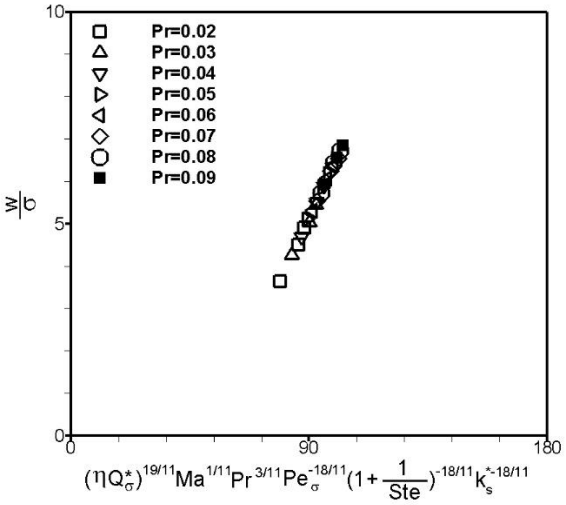


Figure 3 Comparison between scale analysis and numerical computation of fusion width for different Prandtl numbers

Recent Publications (minimum 5)

1. Wei PS, Chao TC (2016) The effects of drilling parameters on pore size in keyhole mode welding. ASME Journal of Manufacturing Science and Engineering 138: 021008.
2. Wei PS, Chang CC(2016) Existence of universal phase diagrams for describing general pore shape resulting from an entrapped bubble during solidification. ASME Journal of Heat Transfer 138: 104503.
3. Wei PS, Hsiao SY(2016) Effects of mass transfer coefficient on pore shape in solid. International Journal of Heat and Mass Transfer 103: 931-939.
4. Wei PS, Hsiao SY (2016) Effects of solute concentration in liquid on pore shape in solid. International Journal of Heat and Mass Transfer 103: 920-930
5. Wei PS, Liu HJ(2012) Scaling thermocapillary weld pool shape and transport variables in metals. Welding Journal 91: 187-s-194-s.



Biography

Dr. Peng-Sheng Wei received Ph.D. 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. Dr. Wei 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. Dr. Wei has published more than 80 SCI journal papers, given keynote or invited speeches in international conferences more than 120 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, 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.

Email: pswei@mail.nsysu.edu.tw

Notes/Comment