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Thermal effects on capability of drilling with a high intensity beam

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This study theoretically identifies the factors affecting the keyhole collapse during drilling with a high power density laser or electron beam from fundamental principles of thermal physics. Laser drilling is widely used in various manufacturing technologies. This work studies quasi-steady one-dimensional compressible flow behavior of the two-phase vapor-liquid dispersion in a vertical keyhole of varying cross-section, paying particular attention to the transition between the annular and slug flows. The results show increases in absorbed energy, beam radius, entrained energy and specific heat ratio reduce capability of drilling. The drilling keyhole in which a subsonic gas mixture flows usually gives rise to keyhole collapse. The predicted results agree with physical intuition and exact closed-form solutions derived in the absence of friction and energy absorption. Controlling the factors to enhance efficiency and quality of drilling is therefore provided in this work and informed that would help this recognition.

Biography

Peng-Sheng Wei received 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 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, during 2015-2017.

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