# Microstructure Development Affected by Electrode Geometry during Resistance Spot Welding

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## Abstract (300 word limit)

Resistance spot welding is an important technique often used in joining thin workpieces in different manufacturing, aerospace, aeronautics and automobile industries. This presentation theoretically and quantitatively investigates and interprets processes by realistically accounting for transient magneto-fluid mechanics, heat and species transport, and temperature-dependent bulk resistance in workpiece, and film and constriction resistances at contact interfaces. Since temperature gradient and solidification rate are found, the computed morphological parameter, namely, the ratio between temperature gradient and solidification rate, shows that electrode geometry can be designed to control microstructures of the weld nugget.

## Image

Figures 1(a) and (b) show that solidification rate decreases whereas heat flux increases as electrode face radius decrease, respectively. A decrease in electrode face radius therefore increases the morphology parameter, leading to columnar dendrites, whereas cooling rates can be decreased or increased.

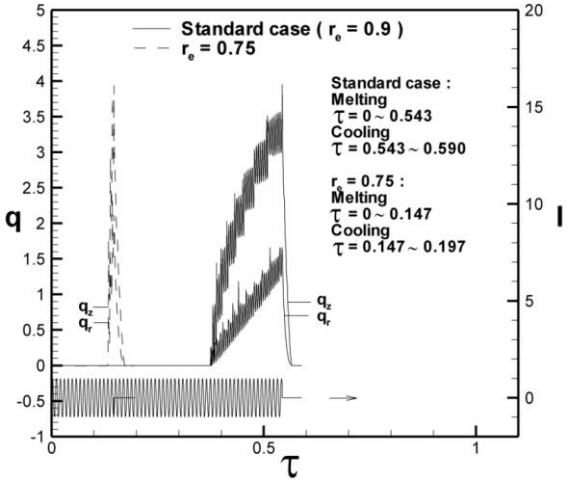
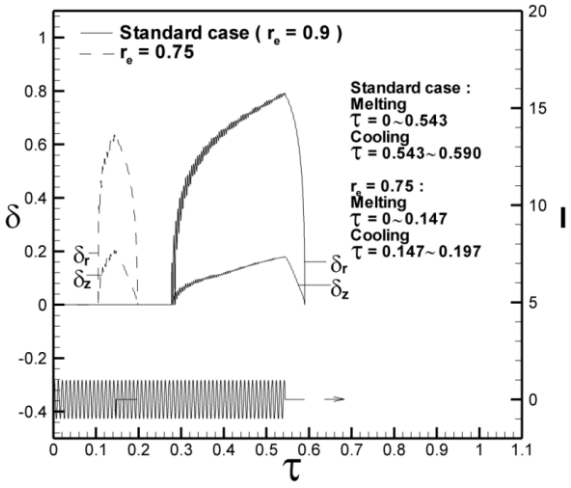



Fig. 1 (a) Growth and recession rates of nugget, and (b) heat flux or temperature gradient in radial and axial directions for different electrode face radii.




## 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. Hsiao SY, Wei PS (2016) Case study of terrestrial or ambient pressure effects on pore shape in solid. AIAA Journal of Thermophysics and Heat Transfer, (in press)



## 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 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, 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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