

Experimental and Numerical Studies of Droplet Formation

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Abstract : Droplet formation is an important process in many engineering systems and manufacturing procedures, which includes welding, biotechnologies, 3D printing, biochemical, biomedical fields and many more. The volume and the characteristics of droplet formation are generally depended on various material properties, microfluidics and fluid mechanics considerations. Hence, a detailed investigation of this process, with the aid of numerical computational tools, are essential for future design optimization and process controls of many engineering systems. This will also improve the understanding of changes in the properties and the structures of materials, during the formation of the droplet, which is important for new material developments to achieve different functions, pending the requirements of the application. For example, the shape of the formed droplet is critical for the function of some final products, such as the welding nugget during Capacitor Discharge Welding process, or PLA 3D printing, etc. Although, most academic journals on droplet formation, focused on issued with material transfer rate, surface tension and residual stresses, the general emphasis on the characteristics of droplet shape has been overlooked. The proposed work for this project will examine theoretical methodologies, experimental techniques, and numerical modelling, using ANSYS FLUENT, to critically analyse and highlight optimization methods regarding the formation of pendant droplet. The project will also compare results from published data with experimental and numerical work, concerning the effects of key material parameters on the droplet shape. These effects include changes in heating/cooling rates, solidification/melting progression and separation/break-up times. From these tests, a set of objectives is prepared, with an intention of improving quality, stability and productivity in modelling metal welding and 3D printing.

Keywords : computer modelling, droplet formation, material distortion, materials forming, welding

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