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Effect of Vibration Amplitude and Welding Force on Weld Strength of Ultrasonic Metal Welding

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Abstract : Ultrasonic metal welding has been the subject of ongoing research and development, most recently concentrating on metal joining in miniature devices, for example to allow solder-free wire bonding. As well as at the small scale, there are also opportunities to research the joining of thicker sheet metals and to widen the range of similar and dissimilar materials that can be successfully joined using this technology. This study presents the design, characterisation and test of a lateral-drive ultrasonic metal spot welding device. The ultrasonic metal spot welding horn is modelled using finite element analysis (FEA) and its vibration behaviour is characterised experimentally to ensure ultrasonic energy is delivered effectively to the weld coupon. The welding stack and fixtures are then designed and mounted on a test machine to allow a series of experiments to be conducted for various welding and ultrasonic parameters. Weld strength is subsequently analysed using tensile-shear tests. The results show how the weld strength is particularly sensitive to the combination of clamping force and ultrasonic vibration amplitude of the welding tip, but there are optimal combinations of these and also limits that must be clearly identified.

Keywords : ultrasonic welding, vibration amplitude, welding force, weld strength
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