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Arc Characteristics in Double-Pulsed VP-GTAW for Aluminum Alloy

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Abstract:

This paper studied the variation in arc profile and arc macroscopic electromagnetic force with double-pulsed variable polarity gas tungsten arc welding (DPVP-GTAW) for aluminum alloy, using a synchronous acquisition and analysis system. The arc shapes were regionalized into arc edge region and arc core region by image processing method based on the gray level of the arc images. The arc characteristic size such as arc electrode end diameter D_E, arc workspace end diameter D_B and arc length L were measured and analyzed in the arc core region. In variable polarity pulse phase, D_E and D_B decreased, while L increased when welding current switched from negative polarity to positive polarity. D_E, D_B and L were all much larger in low-frequency pulse on t_p compared with those in low-frequency pulse off t_b. The size of arc profile changed periodically between t_p and t_b throughout the welding process. The arc macroscopic electromagnetic force F_z and arc pressure P_z oscillated in cycles with the variation of arc profile, inducing the refinement of weld zone grain structure.

Keywords: Arc profile; Double pulse; VP-GTAW; Electromagnetic force

1 Introduction

Variable polarity gas tungsten arc welding (VP-GTAW) is a very precise and clean welding process that has been extensively used in aeronautics, astronautics and automobile industry to produce high-quality weld joints of aluminum alloy as demonstrated by Pan et al. (2016). Wang et al. (2004) indicated that the welding