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MANUSCRIPT

Numerical Simulation of the Formation of Hourglass Welds during Laser Welding

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Abstract

The purpose of this study is to understand the effect of laser welding parameters on the formation of hourglass shaped welds in low carbon steel. Transient laser welding is modeled in ANSYS to simulate the coupled heat-transfer/fluid-flow behavior that produces corresponding hourglass shaped melt pool geometry. Characteristics of the hourglass mode are full narrow penetration and wide surface of molten pool. Recoil pressure induced by rapid metal vaporization strikes the melt pool to form a deep and narrow key hole. Simultaneously, surface tension minimizing its surface free energy primarily acts to widen the melt pool. Comparison of the weld geometries show that welding parameters associated with changes in the melt fluid dynamics are of great importance in the formation of the hourglass shaped melt pool during laser welding.

Keywords

Laser Welding, Keyhole, Hour-glass mode, Numerical Simulation, Surface Tension, Melt Penetration, Recoil Pressure

1 Introduction

Innovative laser welding processes are of considerable interest in numerous industrial applications. The advantage of the laser welding process is the generation of a dense, high intensity heat source that can provide