The role of gas flow in laser cutting with dynamic beam oscillation

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Abstract

In laser fusion cutting, the high-pressure gas flow plays a fundamental role for melt removal and kerf formation. In particular, the basics of momentum and heat transfer between gas and material in standard laser fusion cutting were reported recently [1]. The method of dynamic beam oscillation in laser cutting primarily attempts to increase the absorption of the laser radiation in the process zone [2, 3] but can also be used to shape the kerf for an improved gas flow by an oscillation of the focal position of the laser beam [4]. For dynamic beam oscillation in cutting direction, it was recently demonstrated that strongly localized absorption and heating leads to a periodically changing front geometry and oscillating melt ejection [5]. While local evaporation has been discussed as a cause, the variations of the front geometry also have a decisive influence on the cutting gas flow in the kerf. This poster shows results of computational fluid dynamics (CFD) simulations of the cutting gas flow for an average oscillation cycle. The findings reveal an oscillating gas flow particularly in the lower kerf with a periodic separation and intermediate reattachement of the gas to the kerf front. This behavior leads to a time-dependent momentum transfer to the melt surface and contributes to a periodic explosion-like melt ejection. The results show that, in addition to the improved absorption of the laser beam, the gas flow dynamics have a major influence on the process result in laser cutting with dynamic beam oscillation.

Literature

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