Design of experiments applied to Ti6Al4V laser cutting

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The main goal of this work was to establish the requirements for laser processed parts to satisfy uniform surface finish, low roughness and preservation of the mechanical and functional properties of the parts[1]. Lasers became a versatile machining tool that satisfies the modern trends in material processing, and in this study, the cutting quality factors of sheets of pure titanium and its alloys, cut by pulsed Nd:YAG laser, were investigated according to the Design and Analysis of Experiments (DOE)[2]. Laser pulse energy, laser pulse length, pressure of the protective/reactive gas, cutting speed, were considered the key laser parameter processing factors. In this Design, a factorial arrangement, regarding several combinations of these different processing factors, was performed and the influence of each one was also taken into consideration. The cutting process was performed on commercially pure titanium (grade 2) and the alloy Ti-6Al-4V (grade 5) sheets. The obtained samples were analyzed through optical microscopy in order to determine the edge roughness and dross formation. The samples were also analyzed by scanning electron microscopy and submitted to micro hardness tests and surface roughness inspections. A small increase on the surface hardness on the cut region, due to phase changes, was observed and the formation of nitrogen precipitates under a thin layer of a melted zone were almost eliminated even in nitrogen assisted cutting. Dross formation was greatly reduced virtually eliminating reworking necessity. In spite of the complexity of the interactions among this diversity of parameters, it is possible to optimize the titanium laser cutting by DOE analysis.

Keywords: laser machining; Nd:YAG laser; titanium; design and dnalysis of experiments.(DOE).

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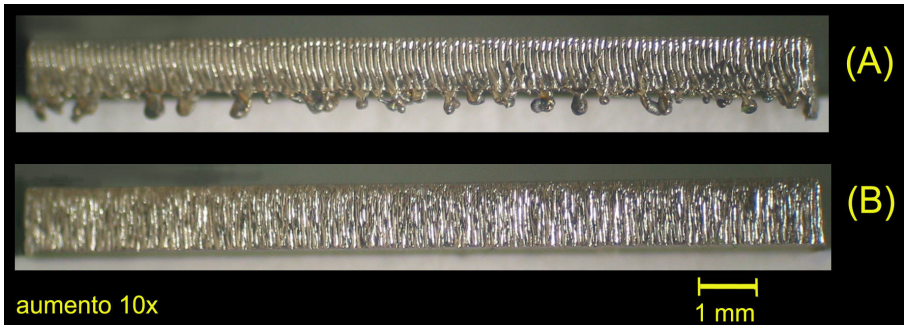

Ti-6Al-4V cut surface (a) at the worst condition (b) better result for four factor DOE.

[1] I. A. Almeida, W. de Rossi, M. S. F. Lima, J. R. Berretta, G. E. C. Nogueira, N. U. Wetter, N. D. Vieira Jr. Journal of Materials Processing Technology, **179**, 105, (2006).

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