Gas shielding analysis in Ti6Al4V pulsed laser beam welding

D. R. Silva[1], J. R. Berretta[1], M. S. F. Lima[2], M. D. M. Neves[1], W. de Rossi[1]

[1] *Instituto de Pesquisas Energéticas e Nucleares, São Paulo, SP, Brazil*
[2] *Instituto de Estudos Avançados/CTA, São José dos Campos, SP, Brazil*

Titanium is a light and resistant material that has applications in many areas, such as medical, aeronautic and nuclear [1-4]. However, due to its high temperature reactivity with oxygen and other air elements, welding of this material may be very difficult. The use of high intensity energy sources such as the laser generates a smaller heat affected zone, reducing the oxidized area. Nevertheless, there is still the need for using a neutral gas protection such as helium, argon or both. This protection interacts with the process through changes in plasma formation, modifying characteristics of the weld, as the weld width and penetration, or even the appearance of porosity. Optimization of this gas protection is necessary to achieve better results with fewer costs.

To optimize the gas protection, it was first found a good weld condition that lead to full penetration of the material with minimum loses (figure 1). This was done using the results from previous works [5] and changing focal position until getting good results. After this, it was used helium, argon and mixtures of these gases as gas shielding both in axial and in back protection.

The analyses were done through the use of mechanical tests such as tensile, bending and hardness tests and visual inspection. The results showed that only a 5 l/min argon flux in axial shielding is needed to protect the weld from oxidation and that, although oxidation was found in the back of the welds, no backshielding was needed. The samples had ultimate strength higher than the base material, showing that the conditions used are appropriate for this alloy.

Keywords: laser welding, Ti6Al4V, gas shielding.
Work supported by FAPESP Proc.: 06/52778-1 and CNPq proc.: 420156/2005-4.

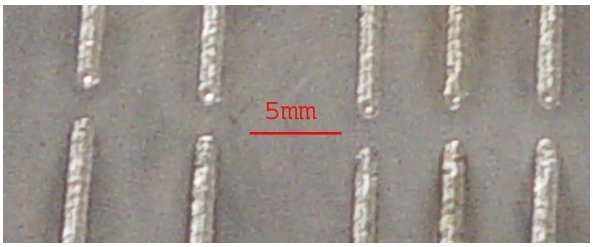

Fig.1 Welds in different conditions.

[1] E. W. Collings, American Society for Metals. Metals Park, 261 (1984).
[2] C. A. S., Bento, Dissertação de mestrado – Universidade Federal de São Carlos, São Carlos (2000).
[3] E. Rolinski, J. Nuclear Materials, **256**, 200 (1998).
[4] J. C. Ion, Laser Processing of Engineering Materials – Principles, procedure and industrial application, Ed. Elsevier, Londres (2005).
[5] D. R. Silva, W. de Rossi, et. al., Soldagem a laser de ligas de titânio, In: 4º Congresso Brasileiro de Engenharia de Fabricação (2007).
e-mail: drsilva@ipen.br