DEVELOPMENT OF INDUSTRIAL LASER APPLICATIONS

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A homemade prototype of a Laser Material Processing Center LMPC has been used for several kinds of materials processing with many advantages when compared to conventional c.w. CO_2 lasers. Besides cutting metals with superior quality, other applications have been developed.
Concerning drilling of metals, it was possible to obtain holes with diameters in the range of dozen of micrometers. Cosmetic characteristics of these holes can be controlled, resulting in low taper, low recast layer and also low dross. The accuracy of the diameters is about 5%. These high precision holes find practical applications in many cases. Here we show two of then:
- Tilted hole perforation in rings of hard steel used for refrigeration in high-speed dental rotors.
- Development of precision hole drilling with several different diameters made in stainless steel. These holes are also tilted with respect to a cylindrical surface and are an important part of a nozzle assembly used for fuel injection. This piece (FIG.1) is part of a Brazilian program to develop a liquid propulsion system for rockets. In this case, there is collaboration between our institute, another governmental organization and a private enterprise.

The LMPC is an integrated CAD-CAM system. Other outstanding features of the LMPC system are the precision control of pulse energy, the possibility of changing temporal and spatial profile of the laser beam and the precisely controlled positioning system.

These important characteristics allowed us to perform delicate welds, difficult or impossible to obtain by other methods. Among then we have developed dissimilar welds joining nickel alloys as inconel 600 and stainless steel as AISI 304 and AISI. All combinations between two of these elements have been joined to form the propulsion system of a new Brazilian satellite.

Other remarkable development in welding was the joining between titanium and AISI 1020 steel, a very difficult and important weld used mainly in the aero spatial industry. This weld process was developed in collaboration with IEAv-CTA (Instituto de Estudos Avançados - Centro Técnico Aeroespacial).
Concerning cutting, many important developments were made with respect to titanium alloys. Special effort has been made to obtain a good quality cutting, resulting in surfaces free of impurities with low dross and rugosity. These characteristics are important in some applications as in fabrication of medical and odontological implants.
All these developments were made in collaboration with governmental and private enterprises and were sponsored by then and by the "Instituto Fábrica do Milenio" PADCT-CNPq-MCT program, a governmental agency.

FIGURE 1 - Piece of a fuel injection nozzle drilled by the LMPC.