Laser material processing at IEAv

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The Instituto de Estudos Avançados – IEAv deals with laser development and applications since 1981. The crescent demand for industrial laser applications steered the creation of a laboratory entirely devoted to the development of technological applications at the Institute. The Laboratory for Development of Applications of Lasers and Optics (DEDALO) was originated in 2003, as an open facilities-lab aiming new applications of lasers and optics technologies. The facilities include pulsed and CW lasers ranging from infrared to ultraviolet, which allow processing several materials, such as polymers, metals and ceramics. Currently, the main research activities at DEDALO lab, that will be overviewed here, are in the following areas:

- Laser surface treatment, with the aim to improve or enhance the properties of metallic surfaces. Both laser heat treatment and laser alloying process are used to increase of surface hardness and to reduce the friction coefficient and the wearing of mechanical components.
- Laser surface structuring and texturing to control of surface roughness in order to obtain better adhesion of hard layers on substrates, increasing the lifetime of mill and forging tools; the process is also used to improve surface lubrication of automotive components.
- Laser sinterization of metal or ceramic powder for rapid prototyping of mechanical components; the process under development is carry out by sinterization of successive thin layers allowing fabrication of complex 3-D structures.
- Laser beam welding of aeronautical aluminum using a high power fiber laser, which aim is replacing riveted aeronautical and aerospace structures.
- Laser beam micro-welding of very thin metallic foils by using short nanosecond pulsed lasers for applications like sensors and insulator membranes;
- Laser beam joining of cable-connector electrical contacts used in avionics;
- Laser induced fracturing process to improve manufacturing time of automotive components; the technique is also been used to fabricate rupture diaphragms with exceedingly control of hypersonic shock tunnel working pressure;
- Real time measurement of laser beam quality; the innovative method based on light scattering imaging can measure beam quality factor of only one single laser pulse.

Keywords: laser material processing, laser welding, laser surface treatment, laser drilling, laser structuring.

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