Lasers Technology

Single crystal fibers growth

Lasers Technology

Introduction

The Lasers Technology Program of IPEN is committed to the development of new lasers based on the research of optical materials and new technologies, as well to laser applications in several areas: Nuclear, Medicine, Dentistry, Industry, Environment and Advanced Research. Additional goals of the Program are human resource development and innovation, in association with Brazilian Universities and commercial partners. The Program is basically divided into two main areas.
"Material and Laser Development", includes crystal growth of optical materials (laser crystals); characterization, modeling and optical spectroscopy of solids, plasmas and biological materials; development of compact diode pumped-solid state lasers and the development of a high power (TW) laser system, one of the main projects of the Center for Lasers and Applications. High power ultrashort pulses lasers based on Chirped Pulse Amplification technologies and Ti:Sapphire gain media, allowed the generation of TW peak power on top of conventional optical tables and the realization of relativistic intensities (10^{18} W/cm^2) at modest costs.
The main area, "Laser Applications", is concerned with technological laser uses such as laser processing, laser remote sensing, development of new diagnostic and therapeutic methods such as optical coherence tomography (OCT), laser Doppler flowmetry, photosensitization, prevention of dental caries, plus other advanced applications of high intensity lasers.
Recent activities are highlighted bellow:

- Development of single crystal fibers for compact laser systems;
- Growth of a solid solution $LiGd_{0.232}Lu_{0.75}Nd_{0.018}F_4$:Nd crystal suitable to obtain a laser medium for mode-locking purposes;
- Characterization, modeling and optical spectroscopy of rare-earth doped crystals and glasses for the development of solid laser medium;
- First single crystal Nd:YLF fiber laser;
- Evaluation of the performance of fs laser-induced Breakdown Spectroscopy (fs-LIBS) for the determination of elements in animal tissues.
- New method for the evaluation of microvascular functionality using low-frequency fluctuations in the laser Doppler flow signal;
- Construction of an automatized workstation with ultrashort laser pulses (femtoseconds) for the study of thermal and non-thermal processes in dielectrics, semiconductors and metals;
- Study of a therapeutic method combining Nd:YAG laser and topical fluoride treatment for effective reduction of caries incidence in patient.
- Development of studies showing that photodynamic antimicrobial therapy is able to reduce 99% of multi-resistant bacteria in burn wounds.
- Analysis of Optical Coherent Tomography applied to dermatology (research work winner of the Natura Campus 2010 Premium for Technological Innovation),
- New LIDAR system for Industrial Emission and Detection installed in Cubatão/SP (collaboration in The National Institutes of Science and Technology Program /INCT).
- Studies for isotope enrichment by ultrashort laser pulses.

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Lasers Development

Crystal growth

[illegible]

Bulk single crystals growth

[illegible]

Single crystal fibers growth

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Development of compact diode-pumped solid-state laser sources

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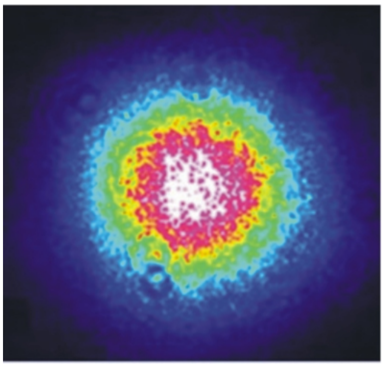
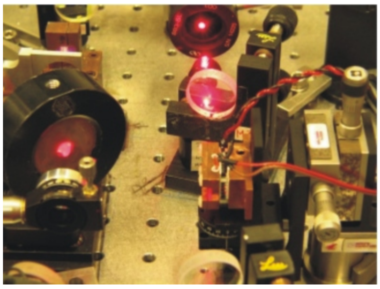
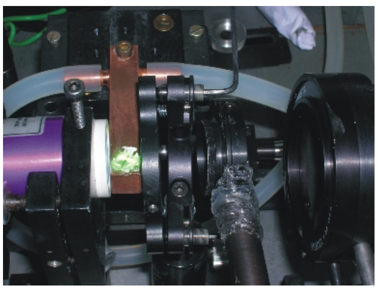
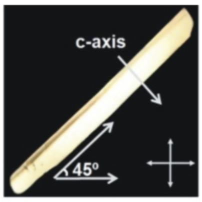
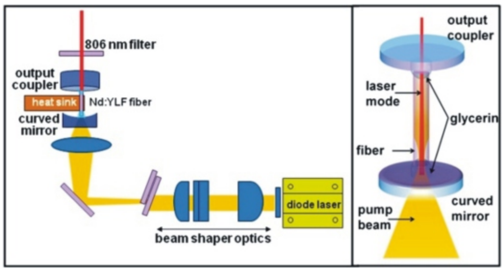




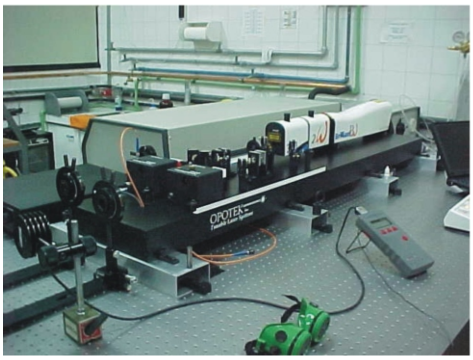






Production and optical characterization of active laser media based on nanopowders and metamaterials

Characterization, modelling and optical spectroscopy of rare-earth doped solid laser media



Characterization, modeling and optical spectroscopy of plasmas

Microvascular function evaluation by low-frequency fluctuations in the laser Doppler flow signal

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Laser processing of special materials: thermal and non-thermal process

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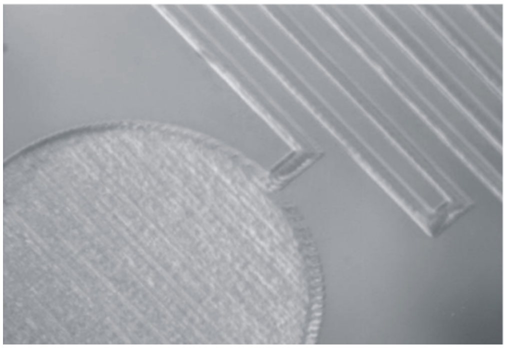

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Physical characterization of biological tissues for the development of new diagnostic and therapeutic methods

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Prevention of dental caries with lasers “in vitro”

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Prevention of dental caries with lasers clinical trial

[illegible]

[illegible]

Lasers in Periodontology - clinical trial

[illegible]

Development of therapeutic processes of photosensitization and photobiomodulation

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Photobiomodulation

[illegible]

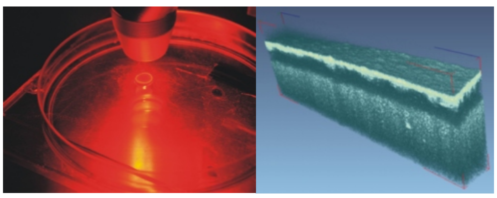
Photosensitization

[illegible]

[illegible]

Optical coherence tomography applications

[illegible]



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Laser remote sensing of the atmosphere

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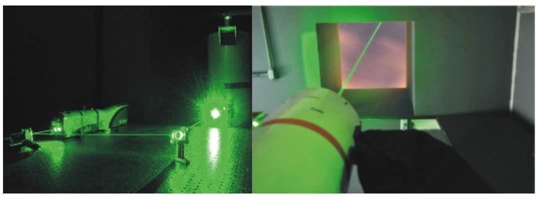

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Operation and optimization of the TW peakpower laser and applications

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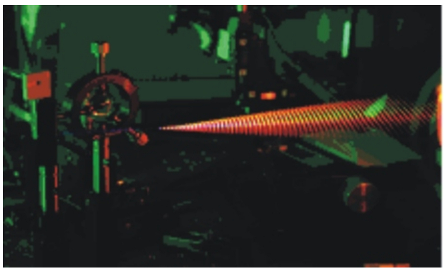

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Color center production by high intensity ultra short laser pulses

[illegible]

Pump and probe studies of ultrafast magnetization dynamics in the femtosecond timescale

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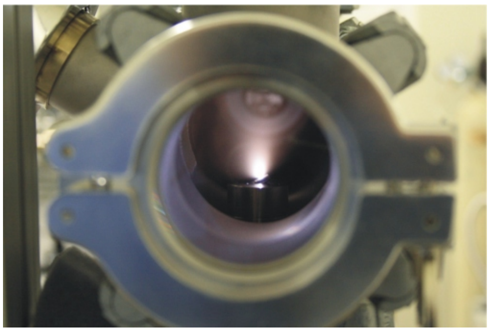
Lasers Technology

High Intensity Lasers

Determination of the ultrashort pulses ablation threshold of solid samples

Generation of high harmonics into the VUV and soft X-ray spectral regions



Lasers Technology

Program Team

Research Staff

[illegible]

Graduate Students

[illegible]

Co-Workers

[illegible]

[illegible]

Honor Mention and Awards

[illegible]

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Program Team

Honor Mention and Awards