NEWSLETTER LIFT #6
April 2011

APPLICATION ORIENTED RESEARCH IN THE AREA OF HIGH-BRILLIANCE FIBRE LASERS

Contents of this newsletter

Fibre Lasers: Component and System Reliability

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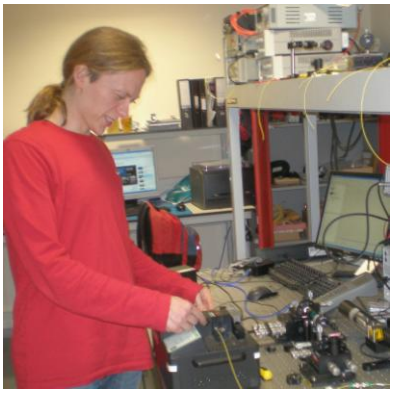
Higher system reliability increases brilliance. Work Package 3 (WP3) develops higher reliability by raising the thresholds for optical damage and degradation from optical and thermal effects. This leads directly to higher brilliance, because the laser can generate greater levels of useful optical power without suffering degradation.

LIFT has a core vision that the pathway to higher brilliance is to design components that can handle higher levels of optical power. However managing the total optical power so that individual components and systems do not suffer damage requires R&D to improve reliability.

The LIFT Project will improve the understanding of both long-term (e.g. photodarkening) and instantaneous system degradation (e.g. laser diode or fibre component failure due to high optical power levels). It will gather real system reliability data and attempt to quantify the improvement to system reliability obtained through the developments made in the LIFT project.

Photodarkening is the generation of additional loss when a material is irradiated at specific wavelengths. The problem arises when the Yb-doped fibre is irradiated by the pump light, this will degrade laser performance. In this case the fibre exhibits extra propagations losses that evolves in time until saturation is reached. The size of the saturated losses and time evolution depends on the doping levels, glass core composition and by the inversion required. This means that photodarkening depends not only on the type of fibre but also on the way it is used. Photodarkening has been considered by many to be a bottleneck towards scaling-up the output power of Yb-doped fibre lasers.



Hrvoje Gebavi from University of Swansea splicing test fibres

The LIFT project approaches the problem in two ways: first we investigate the photodarkening mechanism to develop new recipes for photodarkening improved fibres. In parallel we develop a protocol for a standard measurement system to be able to compare performance of all kind of fibres. Within LIFT this activity is carried out by Swansea University , UK, on fibres and Politecnico di Torino, Italy, on preforms with the collaborations of fibres manufacturers partners and lasers makers, such as Perfos , France, iXFiber, France, NKT Photonics, Denmark, SPI Lasers, UK, and EOLITE, France.

For more information: Tom Pearsall
pearsall@epic-assoc.com

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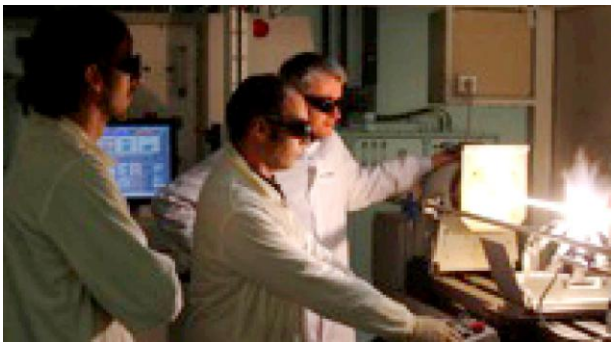
Thanks to the impressive LIFT consortium, the investigation of photodarkening mechanisms is able to generate a wide variety of samples covering a large range of core composition and doping levels. To be able to test so many different designs is a key opportunity since it allows a comprehensive investigation of fibre and material characteristics. Sets of customized samples developed for instance, by PERFOS and , iXFiber to investigate specific issues regarding for instance the influence of doping concentration and of core glass composition are now possible.

Olivier Le Goffic, MCVD specialist at PERFOS



Technicians and Engineers discussing collapse parameters during the last phase of preform manufacturing on a MCVD lathe at iXFiber

For more information, please contact:
Tim Durrant
tdurrant@goochandhousego.com

Alessandro Virga, Daniel Milanese and Fabrizio Giorgis at the Raman spectrometer at the Politecnico di Torino

Early in the program, iXFiber delivered a wide bundle of samples, including experimental fibres, to Politecnico di Torino and the University of Swansea. Politecnico di Torino employs spectroscopic investigation techniques to support preform analysis, in particular UV-VIS and Raman spectroscopies to evaluate the glass structure before and after irradiation. Swansea University tests fibres and model results. Measurement methods have been refined to be sure photodarkening loss is more accurately assessed.

At iXFiber, some hints were collected that the photodarkening could be greatly reduced in the classic Ytterbium-aluminum -doped core, and that negligible photodarkening could be obtained in more complex core compositions. Month after month, the under-standing of the photodarkening process is getting more complete. Testing at the University of Swansea now shows no measurable photodarkening and no evidence of green emission that is one of the signs of occurring photodarkening. Barely 18 months after the official kickoff, a large batch of optimized preforms with reduced photodarkening behavior was delivered to NKT Photonics to be use in a fiber milestone part of Work Package2.

This project will have a large impact on the European and worldwide community since it will pave the way to a new generation of photodarkening-free fibres supporting the new generation of high-power lasers.

Since the LIFT project is aimed to support the EU competitiveness and provide dissemination of its activity Work Package 6 in collaboration with Work Package 3 organized the “1st International Workshop on Photodarkening in Optical Fibres” in Dresden in October 2010. This initiative was described in the LIFT Newsletter #3. Future workshops are being planned.

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