ANNOUNCEMENT OF A PhD THESIS POSITION

The "Laboratoire de Physique de la Matière Condensée" (LPMC – UMR 6222, CNRS-University of Nice-Sophia Antipolis) invites applications for a PhD thesis on the topic below. This thesis work is part of the PARADYSIO project (2012-2014) supported by the French National Research Agency (ANR) and leaded by LPMC.

Study of Photo- and Radio-Darkening of Ytterbium-Doped Silica Optical fibres

Ytterbium-doped silica optical fibres (YDF) are of major interest in a wide variety of industrial, military or medical applications requiring efficient high power laser sources operating near 1 micron. YDF should notably be used in space, in high data rate fibre-based transmitters for large distance inter-satellites communication (Optical Inter-Satellite Links, OISL) or for remote sensing (LIDAR). The technological development of YDF for such applications is strongly limited by two detrimental effects that both result in "darkening", a considerable excess optical loss that develops across the UV, visible and near-IR spectral ranges. By affecting pump and gain wavelengths, this excess loss has dramatic consequences on the laser performance. The first darkening effect is induced by the pump photons themselves and is known as photo-darkening. It has become critical in high power fibre amplifiers. The second one is due to the natural ionizing radiations of the space environment and is referred to as radio-darkening.

Photo- and radio-darkening have been investigated by separate communities so far, each with its own motivation. By combining high power fibre-based laser sources and the harsh space environment, OISL and space-based LIDAR applications nevertheless raise the question of the coexistence of both darkening sources, i.e. the question of simultaneous photo-radio-darkening (PRD). It is now admitted that darkening effects result from the appearance of radiation-induced colour centres, but neither the nature of these centres nor the detailed mechanisms of their formation/annealing are clearly identified. Some of our preliminary results demonstrated that photo- and radio-darkening involve partly identical defects, thus showing that competition effects such as mutual mitigation may exist in case of PRD. This finding sets up the need for a joint approach.

A basic challenge in this study will be to reproduce space-equivalent irradiation conditions. Space radiations are characterized by very low dose rates (10^{-4} – 10^{-2} Gy h^{-1}) acting over the duration of the spacecraft mission (about 15 years). Ground tests assessing the radiation resistance of components to be flown in space must therefore be accelerated, i.e. conducted at much higher dose rate in a much shorter time, but lead to the same degradation level as a mission. PRD and the design of relevant ground tests protocols for YDF-based laser sources are two problems that have never been explored. The basic objectives of the PARADYSIO project consist in determining proper conditions for space-equivalent accelerated tests and in developing PRD-resistant YDF-amplifiers capable of maintaining their performance within a given tolerance throughout a typical mission. To meet these objectives, the project team offers a close concentration of expertises in fibre design and fabrication, irradiations (including protons), defect characterization and modelling.

The PhD student will be involved in the physical characterization of PRD effects in YDF. This characterization will be achieved as a function of the doping of the fibre core, through a detailed consideration of total dose and dose rate effects. Aside from standard radiation-induced attenuation (RIA) measurements, the photo- and radio-induced induced defects will be characterized by coupling thermally stimulated luminescence (TSL) and EPR measurements (EPR at LSI, Ecole Polytechnique Palaiseau, France). TSL is a powerful technique that reveals all the defects and centres activated by irradiation. All the characterizations are intended to provide a fine understanding of the physical mechanisms of PRD (with its decisive factors) and to allow us to build a PRD simulation tool. This tool will serve as the basis for both the search for accelerated tests conditions and the development of PRD-hardened fibres. The PhD student will also take part in the set up and use of the bench dedicated to accelerated tests of YDF-based laser operated under irradiation. Simulations, fibre design and fabrication, and accelerated tests will run according to a feedback loop that is expected to converge efficiently towards the sought objectives.

Location: University of Nice-Sophia Antipolis, Faculté des Sciences, Parc Valrose, Nice. Laboratoire de Physique de la Matière Condensée (LPMC, UMR 6622). The laboratory is located in the centre of Nice.
For more information, please log on http://lpmc.unice.fr/.

Start: last quarter 2011 or january 2012. **Duration** : 3 years.

Salary: The gross monthly salary is approx. 1680 €.

Qualification: This position offers inter-disciplinary training in materials physics and guided optics, in experimental techniques and modelling. Applicants should possess a Master 2 degree (or equivalent), preferably in materials physics or photonics. Candidates from other related fields will also be considered; they should be familiar with optical fibres, lasers and materials (semi-conductor/dielectric) physics. Programming skills (Matlab) will be an asset.

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