


Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (**ne pas dépasser 1 page**)

Date de la proposition : 14/01/2016

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Lieu du stage / internship place: Marseille (campus de Luminy)	



Titre du stage / internship title: Endommagement laser en régime ultrarapide / Laser damage in ultrashort regime
Résumé / summary <u>1. Scientific context:</u> Damage of solids by ultra-short laser pulses has strong applied and fundamental interest. Laser-induced damage threshold of optical materials in ultra-short regime ($\ll 50$ fs) are indeed much smaller compared to longer pulse durations [1], making sensitive the problem of the fragility and reliability of the optical components. This is crucial in particular in the context of development of ultra-intense laser sources (typically 10 PW – 150 J/15 fs) today in the world. Moreover, the mechanisms of laser-matter interaction remain largely unknown for ultra-short pulse durations (10-50 fs) requiring detailed investigation to be properly characterized. <u>2. Description of works:</u> The student will participate to the development of experiments aiming to diagnose the mechanisms of laser energy deposition at the surface of dielectrics and metals irradiated by ultrashort pulses (down to ~ 15 fs pulse duration). After learning using our ultra-short laser-damage test-bench, the student will perform experimental studies of laser energy deposition and damage on dielectrics (fused silica, sapphire) and metal targets (copper, aluminum). The objectives are: i) to measure the damage thresholds at ultra-short time scale (15-50 fs) and at different wavelengths (800 nm, 400 nm mainly), ii) to study the determinism of laser damage in the ultrafast regime, and iii) to evaluate the quantity of the laser pulse energy which is deposited in the material by means of reflectivity/transmissivity measurements of the pump pulse [2-4]. In particular, the numerical aperture of the focusing element and the thickness of the target will be two important parameters of the study. To carry out the research, the student will use the ASUR laser platform of LP3 laboratory. ASUR is a highly advanced ultrashort TW laser source (800 nm, 10/20 TW, 25 fs nominal, < 15 fs available, OPA fs: UV – IR). Advanced diagnostics tools are available in the lab: AFM, SEM, optical microscopy, confocal and Raman. <i>NB : Possibility to continue in Ph'D (DGA/AMU grant acquired; conditions of nationality apply: EU and Swiss only)</i> 1. B. Chimier, O. Utéza, N. Sanner, M. Sentis, T. Itina, P. Lassonde, F. Légaré, F. Vidal, and J.C. Kieffer, “Damage and ablation thresholds of fused-silica in femtosecond regime”, Phys. Rev. B 84, 094104 (2011). 2. N. Varkentina, N. Sanner, M. Lebugle, M. Sentis, O. Utéza – Absorption of a single 500 fs laser pulse at the surface of fused silica: energy balance and ablation efficiency – J. Appl. Phys. 114, 173105, 2013. 3. M. Lebugle, N. Sanner, N. Varkentina, M. Sentis, and O. Utéza, “Dynamics of femtosecond laser absorption of fused silica in the ablation regime”, J. Appl. Phys. 116, 063105 (2014). 4. M. Lebugle, O. Utéza, M. Sentis, N. Sanner - High temporal resolution and calibration in pump-probe experiments characterizing femtosecond laser-dielectrics interaction - Applied Physics A 120, 455-461 (2015). <u>Connaissances et compétences requises/required skills :</u> Optics and Lasers, Solid and Plasma physics. <u>Moyens Laser / Laser platform :</u> ASUR platform, Multiline femtosecond laser facility (see www.lp3.univ-mrs.fr). <u>Moyens d'analyse/Diagnostic tools :</u> AFM, SEM, Optical microscopy, pump-probe experiments. <u>Rémunération/Salary :</u> ~ 540 € net allowance per month (according the law).
Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? Possibility of a PhD ? : oui/yes		
Si oui, financement de thèse envisagé/ financial support for the PhD: bourse DGA/AMU obtenue		
Lasers, Matière, Interactions	x	Lasers, Optique, Matière
		x

Fiche à transmettre (fichier pdf **obligatoirement**) sur le site <http://stages.master-omp.fr>