Doctoral School 352
Physics and Science of Matter

PhD thesis offer

Title: Improving the lifetime of optics for high power lasers in space

Location: Institut Fresnel, Marseille, France.

Link to postulation web site:
https://recrutement.cnes.fr/en/annonce/1497843-070-improving-the-lifetime-of-optics-for-high-power-lasers-in-space-marseille

Postulation deadline: March 31st 2022
Feedback date: mid-June (or before)
Starting date: October 1st 2022

Requirements: MASTER in material science / physical chemistry / physics; knowledge of surface analyzing techniques is recommended, knowledge in optical instrumentation (lasers) appreciated.

Project description:

The laser as a key enabling technology has entered space applications since some time now. In particular, recent space missions carry instruments like Chemcam, ALADIN and SuperCam that use and will use high power nanosecond lasers in order to achieve performances that cannot be obtained with classical light sources. The lifetime of the high power photonics instruments however is still a critical point. The reason is mainly an effect named “Laser Induced Contamination” (LIC) due to polymers outgassing, which is a special case of multiple pulse Laser Induced Damage (LID).

The LIC effect creates absorbing “layers” (or chemical deposits) of some nanometers thickness on the optical components that are used by the laser. These deposits strongly reduce the performance of the instruments in particular if resonators are concerned [1]. Qualitatively, LIC can be understood as a sort of Chemical Vapor Deposition (CVD)

An experimental setup has been built and validated during the first PhD thesis on this topic and is now ready for more experiments and extensions [2,3]. This new PhD project aims, amongst others, to check experimentally some hypotheses proposed by preceding work and to advance from qualitative models towards quantitative models. Another task is to complete preceding measurements in terms of fabrication of LIC deposits in different experimental conditions and in terms of the analysis of their chemical and physical properties.

Another point of interest could be the comprehension of the different methods that minimize or clean the LIC deposits.

This work thus comprises an experimental and a smaller theoretical part and will take place mostly at the Institut Fresnel at Marseille, France.

References:

[1] ESA, Second laser boosts Aeolus power, European Space Agency. (n.d.). https://www.esa.int/Our_Activities/Observing_the_Earth/Aeolus/Second_laser_boosts_Aeolus_power (accessed October 1, 2021).

[2] G.G. El Reaidy, F.R. Wagner, D. Faye, J.-Y. Natoli, Study of the first stages of laser-induced contamination, OE. 57 (2018) 121903. https://doi.org/10.1117/1.OE.57.12.121903.
[3] F.R. Wagner, G. Gebrayel El Reaidy, D. Faye, J.-Y. Natoli, Laser induced deposits in contaminated vacuum environment: Optical properties and lateral growth, Optics & Laser Technology. 122 (2020) 105889. https://doi.org/10.1016/j.optlastec.2019.105889.

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