

## To Whom it may concern

In the frame of his PhD studies, Juraj Sládek was dealing with surface and volumetric modifications of band-gap materials by ultrashort laser pulses, mainly on silicon and glass.

The PhD thesis reports on the state of the art, the methods and the main results obtained during his PhD. Beside the presentation of the characterization techniques employed during the PhD, the "Experimental methods" chapter, together with some appendices, reports on significant efforts made by Juraj during his PhD. In particular in terms of the experimental setups combining both creation of the optical path arrangements (some of which with in-situ visualization), integration of motorized stages, preparing electronics for synchronization and fixing of motion stages drivers and programming both for scripting the irradiation tests with various parameters and for some of the data analysis and interpretation.

The first part of the results chapter relates mainly on laser-induced damage thresholds (LIDT) of materials that are essential in laser material processing. Instead of a trivial report on damage thresholds, the study reveals surprising features such as the importance of the angle polarization direction with respect to the crystalline orientation of Si samples, disregarded in our community.

In the second part of the results chapter the report focuses on surface texturing of silicon and glass with an emphasis on attempts to obtain regular laser-induced periodic surface structures (LIPSS). Successful generation of regular LIPSS are presented with unexpected but interesting phenomena. For example not only one but several substantially different regimes of laser fluence and pulse overlap are identified for which good regularity can be achieved; the generation of stripes of low spatial frequency LIPSS on silicon forming perpendicularly to the scanning direction and at the periphery of individual (spatially Gaussian) laser pulses during scanning; the possibility of obtaining, in the imprint of each individual pulses, a check-patterns of LSFL when cylindrical lens is used... Juraj Sládek also managed, through further investigations, to convincingly explain some of the observed effects.

Finally, the last part of the results chapter exposes experimental investigations related to volumetric modification of crystalline silicon. Results presented are interesting even though further studies at higher energies and with better laser energy and pointing stability would be needed to obtain comparison with several bandgap materials. This shortage is explained by the decision, with the hierarchy, to shift priorities of Juraj Sládek's PhD towards surface texturing since the laser used for the volumetric modification was still in development, leading to many difficulties.

In spite of this, the objectives, revised after variations in the initial topic planed for his PhD, were achieved. Juraj could integrate very well in the environment and took easily advantage of the various equipment available in the department to perform his work. I would also like to stress the significant supporting work from his initial specialist supervisor Dr. Inam Mirza during the 1<sup>st</sup> half of his PhD, which made it possible to consolidate experimental skills of Juraj with ultrashort laser pulses processing and gave birth to several published works. The ease of Juraj to seamlessly proceed after the change of topic and supervision circumstances evidence again his perseverance and adaptability skills. Curiosity and pragmatism are his great additional skills to carry on in research and engineering with the advantage to care for the unexpected phenomena he might observe experimentally. This is probably the



reason why his help has been solicited very often in the Department of Scientific and Laser Application in HiLASE Centre and why he could take part in several other studies not reported directly in the PhD thesis. He showed also significant independence to solve problems and, in my view, perfect communication. With 3 papers as a first author, 6 as co-author and other works to be submitted soon based on parts of the PhD work, Juraj has also good chances to apply for funding in the future.

In summary, the thesis is well written, contains novelty and well satisfies in my opinion the demands put on a doctoral thesis. Therefore, I recommend the thesis of Juraj Sládek for public defense.

Dr. Yoann Levy, Prague, May 30, 2023

