



Supervisor review of the Ph.D. thesis of Fangxin Yue MSc.

"Development of a cryogenic 2 μm multi-pass amplifier in nanosecond regime"

The topic of Fangxin Yue Ph.D. thesis, diode-pumped lasers and amplifiers based on cryogenically cooled Tm:Y₂O₃ transparent ceramic, is motivated by the increasing application demands on the 2 μm high average/peak power lasers. The work is the result of the author's doctoral study at the Department of Physical Electronics, FNSPE, Czech Technical University in Prague, during the years 2016 - 2020 and at the Department of Physical and Inorganic Chemistry of University of Rovira I Virgili in Tarragona, during the years 2018 - 2020. The main part of the experimental work was performed at the laboratory of HiLASE Centre, Institute of Physics of Czech academy of sciences, Dolní Břežany.

The main goals of the dissertation were as follows: study the material properties of the Tm:Y₂O₃ transparent ceramic, construction of Q-switched, cryogenically cooled Tm:Y₂O₃ laser oscillator, and demonstration of a cryogenic multi-pass amplifier using the Tm:Y₂O₃ transparent ceramic as the gain medium.

The submitted work contains seven chapters and it has 89 pages. The text is supported by 61 figures and 10 tables. After the introduction part of the thesis in which the author explained and summarized the possible generation methods and applications of radiation in the 2 μm range, the state-of-the-art of the thulium-based laser giant pulse generators is given and the objectives of the dissertation are described. Material characterization and spectroscopic properties of Tm:Y₂O₃ transparent ceramics are presented in Chapters 2 and 3. The following three chapters are devoted to the use of cryogenically cooled Tm:Y₂O₃ transparent ceramics for free-running laser construction, for Q-switched pulse generation, and for the construction of a multi-pass amplifier. In Chapter 7, the author summarized and concluded the work and she gave a several proposals for further research and development in the field of cryogenically cooled Tm:Y₂O₃ MOPA laser system. The presented work proves that all goals of the dissertation were accomplished. The results presented in this work have been published in reputable journals or presented at international conferences.

The thesis is written clearly and the facts are arranged logically. The work includes the extensive documentation related to the solved subject. The whole work forms a distinct contribution to the knowledge in the area of thulium-based cryogenically cooled laser oscillators and amplifiers. In the thesis, new substantial facts are presented. The literary presentation is on the highest level.



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It is possible to conclude that Fangxin Yue has been working very hard during the above mentioned years and successfully used the opportunity to work at modern top workplaces with a group of excellent experts from the Czech Republic and abroad. She fulfilled all needed requirements and obtained excellent results. I am convinced that the presented doctoral dissertation proves the author's individual and creative scientific approach and demonstrates her diligence, knowledge and experimental skills.

Based on the facts and opinions stated above, I recommend Fangxin Yue's dissertation "Development of a cryogenic 2 μm multi-pass amplifier in nanosecond regime" to be accepted for the defense and in the case of success I recommend to award her the Doctor of Philosophy degree in Applied Natural Sciences.

In Prague on March 29, 2021

Ing. Jan Šulc, Ph.D.
KFE FJFI ČVUT