

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Timur Yagafarov

PhD Program: Physics

Title of Thesis: Polariton lasing in a dye-filled organic microcavities

Supervisor: Prof. Pavlos Lagoudakis

Date of Thesis Defense: 8 November 2019

Name of the Reviewer: Prof. Dmitry Gorin

I confirm the absence of any conflict of interest	Signature:  Date: 07-10-2019
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Reviewer's Report

The PhD thesis contains 5 Chapters. The first chapter is an introduction, where state of the art in this direction was described in detail as well as main aim of PhD thesis. It is proof of the possibility of control over a polariton lasing emission wavelength and explanation of the blueshift mechanism. The latter is the limiting factor of tunability precision. The PhD thesis topic is interesting for future applications in such field as R&D of wavelength tuneable organic polariton lasers, which utilize strongly-coupled microcavities. Light-matter coupling principles, consideration of the cavity photons and excitons, exciton-polaritons states, as well as polariton lasing process and corresponding mechanisms in the organic microcavities were described in Chapter 2. Chapter 3 is dedicated to the realization of polariton lasing broad wavelength tuneability (of 37 nm) at room-temperature. Organic microcavity design, and developed experimental setup are also explained well. Chapter 4 is addressed to the blue-shifts in organic polariton condensates. The first complex study of a blue-shift origins in the organic polariton condensates was performed and the unique model suggested. Chapter 5 contains the conclusions as well as further outlooks for improvements. The bibliography list consists of 67 references only.

This PhD thesis is an example of a unique combination of high-tech approaches used for the characterization of prepared organic structures and construction of complex setup for dispersion analyses of prepared microcavities.

One part of the main results of PhD thesis has been published in the high impact international journal named Advanced Optical Material (IF=7.125) and Nanotechnology (IF=3.399). Another part was placed in ArXiv (arxiv.org/abs/1905.02573) and currently is under revision in the new journal of Nature publishing group named Communications Physics. The main scope of this journal is significant advances bringing unique insights into a specialized area of research in physics.

The quality of publications is very high and has been confirmed by IF of journals. The contribution of PhD thesis author in the published and submitted articles was described in detail. The level of journals, where PhD thesis results were published, demonstrates the scientific significance of obtained results as well as that one is in the trend of the current state of the art in the organic polaritonics research field. Affiliation of co-authors as well as level of journals and references shows the international standard of PhD thesis results.

One of the perspective directions of application of obtained results, considering the low-intensity levels, is connected with microdisplays or scanning lasers for augmented reality with retinal projection.

It is necessary to consider before the thesis defense the following comments and remarks:

- 1) Page 78. Molar absorption coefficient and molecular weight were given without units. The SI unit of the molar absorption coefficient is $\text{m}^2\text{mol}^{-1}$. Also called extinction coefficient, but usually in units of $\text{dm}^3\text{cm}^{-1}\text{mol}^{-1}$. Molecular weight is measured in unified atomic mass units (u or Da);
- 2) Bibliography list consists of only 67 references. It is an unusual number of references for the PhD thesis. The typical number for a PhD thesis is more than one hundred references.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense