




CURRICULUM VITAE – KRZYSZTOF SAWICKI

PERSONAL INFORMATION

PhD Student, Faculty of Physics, University of Warsaw
E-mail: krzysztof.sawicki@fuw.edu.pl
Date of birth: November 29th 1990
 <http://www.fuw.edu.pl/~ksawicki>
 <https://www.linkedin.com/in/krzysztof-sawicki-72639360/>
 [@ksawickii](https://twitter.com/ksawickii)



My research concerns the intersection of photonics and condensed matter physics with the main focus on topics related to experimental studies of Bose-Einstein condensation of polaritons, polariton lasing from single and coupled microcavities and dynamics of exciton-polaritons, as well as study of single magnetic dopants in quantum dots in self-assembled quantum dots.

SKILLS

Research expertise: Spectroscopy of microcavity systems: single planar microcavities, micropillar microcavities, vertical coupled planar microcavities, polariton lattices; experimental methods: magnetospectroscopy of semiconductor quantum wells and quantum dots, photoluminescence, micro-photoluminescence, photoluminescence excitation, reflectivity, transmission, time-resolved spectroscopy (streak camera), microscopy (scanning electron microscopy, focused ion beam), cryogenics, pulsed and cw lasers; photolithography (spin coating, photoresists), hydrothermal method of nanorods and nanopowders synthesis, wet chemical synthesis of colloidal quantum dots by reverse micelle method; growth of the semiconductor layers by Atomic Layer Deposition; Deposition of dielectric layers by e-beam evaporation.

Simulation of physical effects: Linear and nonlinear optical effects (Gross-Pitaevskii equation), Propagation of electromagnetic waves in dielectric media (Transfer matrix method, FDTD and FEM method).

Scientific software: Matlab, Mathematica, Origin.

Programming languages: Python, Scheme (MEEP).

Teaching experience: teaching undergraduates, conducting workshops for high school students

SCIENTIFIC PROJECTS

Principle Investigator at project PRELUDIUM *January 2018 - January 2022*
Spectroscopy studies of a microcavity exciton-polaritons flow in II-VI semiconductors
Project financed by National Science Centre (Poland), 178 800 PLN (39 324.04 EUR)

Principle Investigator at project ETIUDA *October 2019 - September 2020*
Lasing from a single and coupled double polariton microcavities made of tellurides and selenides
Project financed by National Science Centre (Poland), 140 304 PLN (30 857,49 EUR)

EDUCATION

Ph.D., Physics *October 2014 - September 2021*
Faculty of Physics, University of Warsaw
PhD thesis: *Lasing from a single and coupled double polariton microcavities made of tellurides and selenides*, Advisor: dr. hab. Jan Suffczyński

The doctoral thesis focus on the effects of lasing from semiconductor polariton microcavities made of II-VI compounds. The research carried out as part of the doctoral dissertation showed the presence of all three laser regimes for one structure - polariton lasing, photon lasing with recombination of excitons, photon lasing with recombination of electron-hole plasma. It was confirmed by observing the three laser thresholds in the emission from photonic traps in an optical microcavity based on selenides and tellurides with a single quantum CdSe/(Cd,Mg)Se well. This allowed establishing a previously undetermined relationship between three different laser regimes. Polariton lasing study has also been extended to a system of two coupled semiconductor optical microcavities with quantum wells based on tellurium compounds. Spectroscopic measurements with temporal resolution revealed the complex dynamics of the processes responsible for the excitation transfer between the reservoir of light-created carriers and the polariton levels. The energy-degenerate scattering of exciton-polaritons accompanies the presence of condensate on the higher polariton branch into the lower energetic polariton branch. Systematic measurements for the double microcavity and theoretical modelling made it possible to understand and describe the mechanism responsible for the condensate dynamics in this system.

M.Sc., Engineering of nanostructures

October 2012 - September 2014

Faculty of Physics, Faculty of Chemistry, University of Warsaw

Master thesis: *Spectroscopy of (Cd, Mn)Te/ZnTe quantum dots marked by photolithographic 'in situ' method*, Advisor: dr. hab. Jan Suffczyński

A simple *single-color* photolithography method of permanent marking of the position in a sample of individual semiconductor quantum dots has been demonstrated. The marking is carried out *in situ* during the microphotoluminescence measurement at cryogenic temperatures. It enables multiple studies of the same quantum dot in different experimental setups. Unlike other marking methods, the same laser was used to stimulate photoluminescence from quantum dots and to exposure of the photoresist. In the present work, the marking was used to study the emission properties of single CdTe/ZnTe quantum dots containing a single Mn²⁺ ion. It enabled magnetophotoluminescence measurement of a quantum dot in a magnetic field up to 10 T in two orthogonal configurations: Faraday and Voigt. The ease of application and flexibility of the presented technique allows one to extend its application to other systems with quantum emitters.

B.Sc., Engineering of nanostructures

October 2009 - September 2012

Faculty of Physics, Faculty of Chemistry, University of Warsaw

Bachelor thesis: *Investigation of ZnO nanostructures obtained by hydrothermal method*

Advisors: dr. hab. Jan Suffczyński, prof. dr hab. Marek Godlewski

(in cooperation with Institute of Physics, Polish Academy of Sciences)

In this work, the method of obtaining hexagonal nano- and microrods of zinc oxide using the hydrothermal method is presented. The structures were characterized by Scanning Electron Microscopy and structural X-ray. The measurements showed the presence of a hexagonal crystal structure and a preference for vertical growth of the obtained ZnO microrods. Photoluminescence studies carried out with a spatial resolution of a few micrometres allowed to collect the signal from individual microrods. It enables to observe the near-gap signal typical for volumetric ZnO and the Whispering Gallery Modes. Based on the photoluminescence spectra, the parameters of the micropillar as an optical resonator were determined.

INTERNSHIPS AND COURSES

Internship University of Lille,

January 2020 - July 2020

Villeneuve d'Ascq (France), Advisor: dr. Alberto Amo

- Experimental studies of localization of light and nonlinear effects in photonic graphene

- Simulations of linear and nonlinear effects in honeycomb lattices

Internship Institute of Optoelectronics, Military University of Technology,

April 2013 - September 2013

Warsaw (Poland), Advisor: dr Piotr Nyga

- Investigation of the effect of laser radiation on plasmonic structures produced by e-beam evaporation method

Internship Institute of Physics Polish Academy of Sciences,

July 2011 - October 2011

Warsaw (Poland), Advisor: prof. Marek Godlewski

- Growth of the ZnO nano- and microrods by hydrothermal and Atomic Layer Deposition method

Course Coursera - University of Michigan,*Python Data Structures,*

February 11, 2021

Course Coursera - University of Michigan,*The Science of Success: What Researchers Know that You Should Know,*

February 10, 2021

Course Coursera - Duke University, North Carolina State University & The University of North Carolina at Chapel Hill,*Nanotechnology: A Maker's Course,*

February 09, 2021

Course Coursera - University of Michigan,*Programming for Everybody (Getting Started with Python),*

November 25, 2020

Course Erasmus Intensive Program,*Spintronics and Applications, Chania, Greece*

July 2014

AWARDS

- **Best Poster Award**, Award Committee of 49th International School & Conference on the Physics of Semiconductors "Jaszowiec"2021 for presentation entitled *Bose-Einstein condensation of exciton-polaritons triggered by magnetic field in coupled planar microcavities*
- **Best Poster Award**, Award Committee of 48th International School & Conference on the Physics of Semiconductors "Jaszowiec"2019 in recognition of outstanding presentation entitled *Polariton dynamics in double coupled microcavities*
- **The Dean's of the Faculty of Physics, University of Warsaw distinction** for the outstanding conducting of course *Laboratory of Measurement Techniques* in the academic year 2016/2017.
- **The Dean's of the Faculty of Physics, University of Warsaw distinction** for the outstanding lecture demonstrations *Basic Physics I* conducted in the academic year 2013/2014.
- **The Joanna and Jerzy Glazer Memorial Prize** for the best Master's Thesis carried out on the Faculty of Physics at the University of Warsaw in the academic year 2013/2014.

PUBLICATIONS

- K. Sawicki, T. J. Sturges, M. Ściesiek, T. Kazimierczuk, K. Sobczak, A. Golnik, W. Pacuski, J. Suffczyński
Polariton lasing and energy-degenerate parametric scattering in non-resonantly driven coupled planar microcavities
Nanophotonics 10(9), 2421-2429 (2021).
- M. Ściesiek, K. Sawicki, K. Sobczak, T. Kazimierczuk, A. Golnik, J. Suffczyński,
Long-Distance Coupling and Energy Transfer between Exciton States in Magnetically Controlled Microcavities,
Communications Materials 1, 78 (2020).
- K. Sawicki, M. Jurczak, W. Pacuski, J. Suffczyński,
Direct Interbranch Relaxation of Polaritons in a Microcavity with Embedded CdSe/(Cd,Mg)Se Quantum Wells,
Journal of Electronic Materials 49, 4531–4536 (2020).
- K. Sawicki, J.-G. Rousset, R. Rudniewski, W. Pacuski, M. Ściesiek, T. Kazimierczuk, M. Nawrocki, J. Suffczyński,
Triple threshold lasing from a photonic trap in a Te/Se-based optical microcavity,
Communications Physics 2, 38 (2019).
- W. Pacuski, J.-G. Rousset, V. Delmonte, T. Jakubczyk, K. Sobczak, J. Borysiuk, K. Sawicki, E. Janik, J. Kasprzak,
Antireflective photonic structure for coherent nonlinear spectroscopy of single magnetic quantum dots,
Crystal Growth & Design 17, 2987–2992 (2017).
- J. Papierska, A. Ciechan, P. Bogusławski, M. Boshta, M. M. Gomaa, E. Chikoidze, Y. Dumont, A. Drabińska, H. Przybylińska, A. Gardias, J. Szczytko, A. Twardowski, M. Tokarczyk, G. Kowalski, B. Witkowski, K. Sawicki, W. Pacuski, M. Nawrocki, J. Suffczyński,
Fe dopant in ZnO: 2+ versus 3+ valency and ion-carrier s, p-d exchange interaction,
Physical Review B 94, 224414 (2016).
- K. Gałkowski, P. Wojnar, E. Janik, J. Papierska, K. Sawicki, P. Kossacki, J. Suffczyński,
Exciton dynamics in individual semimagnetic (Zn,Mn)Te/(Zn,Mg)Te nanowires,
Journal of Applied Physics 118, 095704 (2015).
- K. Sawicki, F. K. Malinowski, K. Gałkowski, T. Jakubczyk, P. Kossacki, W. Pacuski, J. Suffczyński,
Single-color, in situ photolithography marking of individual CdTe/ZnTe quantum dots containing a single Mn²⁺ ion,
Applied Physics Letters 106, 012101 (2015).
- J. Piwowar, J. Papierska, K. Sawicki, J. Kobak, W. Pacuski, A. Golnik, P. Kossacki, J. Suffczyński,
Optical properties of CdTe QDs in proximity to a Surface,
Acta Physica Polonica A 124, 5 795-797 (2013).

Oral presentations:

1. APS March Meeting 2021,
Polariton lasing in nonresonantly driven coupled planar microcavities (online conference) 2021.
2. 19th International Conference on II-VI Compounds and Related Materials,
Triple threshold lasing from a photonic trap in a Te/Se-based optical microcavity
Zhengzhou (China) 2019.
3. 19th International Conference on II-VI Compounds and Related Materials,
Determination of vacuum Rabi splitting of exciton-polaritons in a microcavity with CdSe/MgSe quantum wells by photoluminescence excitation
Zhengzhou (China) 2019.
4. 9th International Conference on Spontaneous Coherence in Excitonic Systems ICSC9,
Exploring full space of lasing regimes in the emission from photonic traps in Te/Se based optical microcavity embedding a single quantum well
Montreal (Canada) 2018.
5. 47th "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Polariton lasing from double coupled microcavities
Szczyrk (Poland) 2018.
6. 11th OPTO 2017,
Lasing from a microcavity embedding a CdSe/(Cd,Mg)Se superlattice
Warsaw (Poland) 2017.
7. 46th "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Lasing from a Se-based microcavity embedding a CdSe/(Cd,Mg)Se superlattice
Szczyrk (Poland) 2017.
8. 45th "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Room temperature polariton lasing in a ZnTe based microcavity containing a single CdSe/(Cd,Mg)Se quantum well
Szczyrk (Poland) 2016.
9. 44th "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Towards increased extraction of the light emitted by epitaxially grown quantum dots
Wisła (Poland) 2015.

Poster presentations:

1. 20th International Conference on Physics of Light-Matter Coupling in Nanostructures PLMCN2020,
Triple threshold lasing from a photonic trap in a Te/Se-based optical microcavity
Clermont-Ferrand, France 2020 (online conference)
2. 48th "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Polariton dynamics in double coupled microcavities
Szczyrk (Poland) 2019 (Best poster award)
3. 34th International Conference on the Physics of Semiconductors ICPS2018,
Lasing from a CdSe/(Cd, Mg)Se quantum well embedded into a microcavity in a strong and weak coupling regime
Montpellier (France) 2018.
4. 18th International Conference on Physics of Light-Matter Coupling in Nanostructures PLMCN18,
Lasing from a CdSe/(Cd,Mg)Se superlattice embedded in a ZnTe based microcavity
Würzburg (Germany) 2017.
5. 33rd International Conference on the Physics of Semiconductors ICPS2016,
Single-color, in situ photolithography marking of individual quantum dots
Beijing (China) 2016.
6. 17th International Conference on II-VI Compounds and Related Materials,
Marking of individual CdTe/ZnTe Quantum Dots containing a single Mn²⁺ ion using single-color, in situ photolithography technique
Paris (France) 2015.

7. 43rd "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Positioning of individual Quantum Dots using a single laser beam photolithography
Wisła (Poland) 2014.
8. 41st "Jaszowiec" International School & Conference on the Physics of Semiconductors,
Hydrothermal synthesis and optical characterization of ZnO nanorods
Krynica Zdrój (Poland) 2012.

(Last update 2021/09/17)