KSOP
Karlsruhe School of Optics & Photonics

KIT
Karlsruher Institut für Technologie

Job advertisement

Within the Karlsruhe School of Optics & Photonics (KSOP) there are

4 open positions for Doctoral Researchers (f/m/d)

The Karlsruhe School of Optics & Photonics (KSOP), Graduate School at the Karlsruhe Institute of Technology, provides both multidisciplinary Master and **Doctorate Programs** in Optics & Photonics taught in English.

The educational concept is designed to qualify students for accelerated careers at world leading academic institutions and in high-technology industries. KSOP also has a strong focus on research which shows by the many publications, patents, awards and more that have been achieved by KSOP students, alumni, professors, and members.

We are looking for highly motivated Doctoral Researchers for the following research topics:

Doctoral Researchers

- Doc1: „**Nanophotonic Design of Recombination Layers for Halide Perovskite Tandem Photovoltaics**“, 3 years, funded by fellowship (U. W. Paetzold and R. Guo, Karlsruhe Institute of Technology)
- Doc2: “**Machine Learning for Quantum Information Processing in Hybrid Quantum Systems**”, 3 years, 3260 EUR/ month (A. Metelmann, Karlsruhe Institute of Technology)
- Doc3: “**Computational Nanophotonics**”, 3 years, E13 75% (C. Rockstuhl, Karlsruhe Institute of Technology)
- Doc4: “**Development of active metasurfaces for wavefront shaping and acoustic measurements**”, 4 years, 75% of employment (M.L. Meretska, Karlsruhe Institute of Technology)

Requirements for the application include a degree (MSc or equivalent) with above-average marks in a participating or related field as well as openness to interdisciplinary work for Doctoral Researchers and a completed doctorate for Postdoctoral Researchers.

Additional information about the research topics and requirements on our website. Further questions about the research projects should be directed to the corresponding Principal Investigator.

Applications should be handed in only through our Application Portal. Please indicate the position you are interested in so we can make sure to evaluate your application accordingly. The following documents and data are required for your application:

- CV
- School and University (as applicable: Bsc, MSc, Doctorate) certificates
- Transcripts (BSc and MSc)
- Cover Letter
- Letter of Motivation & Abstract of Research Interest
- Name(s) and contact information for references

Applications should be handed in until **November 10, 2024** and will be evaluated on a rolling basis.

Qualified women are strongly encouraged to apply. Disabled persons with equivalent aptitude will be favored.

Document 1:

Title: "**Nanophotonic Design of Recombination Layers for Halide Perovskite Tandem Photovoltaics**"

Description:

KIT is one of the key players in the field of next-generation photovoltaics for application in solar cells, with a record-breaking track for efficiency in metal halide perovskite-based solar cells. Within the Solar Energy Division, we are working together to realize the full potential of this material as the real-world tandem photovoltaic applications.
Highly effective recombination layers for tandem solar cells should typically possess excellent optical properties with high infrared transparency to ensure sufficient optical absorption for the bottom sub-cell and good electrical performance to extract and recombine excess carriers from both the top and bottom sub-cells. Current challenges are the nano-photonic design of the best recombination layer to deliver the best device performance and operational stability for perovskite-based tandem devices.
These challenges could be tackled by a nanophotonic design approach supported by the effective interplay of chemical, physical, and structural insight through experiments and simulations. How the nanophotonic design of the recombination layer affects structure-property relations in tandem solar cells is necessary for their further development and is the focal point of our research group in LTI and KIT. As a PhD student in our group, you will perform nano-photonic investigation for recombination layers in innovative tandem solar cell research.

Tasks:

- You will employ multiple nanophotonic fabrication ways to process recombination layer materials (e.g., hot-embossing, sputtering, atomic layer deposition, and solution processing) and investigate the effects on device performance for perovskite-based tandem solar cells
- Establishment of the concept of suitable recombination materials for perovskite-based tandem solar cells
- Discovering of how different nanophotonic recombination designs and materials influence the perovskite growth dynamics device performance on different types of perovskite-based tandem solar cells
- Using drift-diffusion simulation to evaluate the band alignment between nanophotonic recombination layers and relative bottom and top solar cells
- Guiding the search for novel halide recombination materials in photovoltaic research within KIT
- Paving the way towards their use in a CO_2-neutral society

Requirements / Profile:

- Master's degree in physics, chemistry, material science, chemical engineering or related disciplines
- Experience in the field of nanophotonic fabrication, halide perovskites or semiconductor device physics, supported by a master thesis in a related topic, is of advantage
- Interest in advanced characterization and simulation methods backed by a curiosity-driven approach
- High level of intercultural competence, ability to work in a team and foster collaboration
- Enjoy experimental work and teamwork
- A proactive attitude and demonstrated good organization/planning skills are highly appreciated
- Previous experience to solar cell fabrication, while not mandatory, is a valuable plus
- Very good written and spoken communication skills in English are required

Duration:

3 years

Salary:

The first year of the fellowship will be funded by a fellowship. The following years will be continued on a position paid at the level of TVL-L

Supervisor:

Prof. Dr. Ulrich Wilhelm Paetzold (ulrich.paetzold@kit.edu)

Dr. Renjun Guo (renjun.guo@kit.edu)

Document 2:

Title: "**Machine Learning for Quantum Information Processing in Hybrid Quantum Systems**"

Description:

The research project aims to optimize control of hybrid quantum systems using machine learning. Objectives include quantum state preparation, optimized measurements, and feedback protocols. Tasks involve developing reinforcement learning strategies for state control, finding optimized measurement strategies, and exploring feedback protocols. Training goals include understanding open quantum systems theory, mastering numerical simulations, and integrating technical skills with scientific knowledge. Expected results include ML-based strategies for state control, optimized measurements, and adaptive control techniques.

Requirements / Profile:

- Master degree in Physics
- Fulfillment of mobility rule: they must not have resided or carried out their main activity (work, studies, etc.) in the host country for more than 12 months in the 36 months immediately before the recruitment date

Selection Criteria:

- Curriculum Vitae, including marks of their BSc and (if it is the case) MSc (35%)
- Background in the concepts and methods of the project (35%)
- Declaration of interest and reference letters (15%)
- Other merits (15%)
- In case of equal qualifications preference will be given to female candidates and to those of underrepresented groups and less favored countries

Duration:

3 years

Salary:

3260.20 EUR/month

Supervisor:

Prof. Dr. Anja Metelmann (anja.metelmann@kit.edu)

Document 3:

Title: "**Computational Nanophotonics**"

Description:

We are currently looking for a PhD student who will take care of the further development of our computational framework to study nanophotonic structures. Our approach is rooted in the scattering theory, where a T-matrix characterizes individual objects.
Once this T-matrix is known, more complicated disordered or periodic photonic materials from many scattering objects can be studied very efficiently. The PhD student we are looking for will continue our prior efforts that led to the development of an open-source software package called "treams." Depending on the specific interests and abilities, the student can render the code more versatile, combine it with approaches that can be used for inverse design, or accelerate the computations by integrating tools from machine learning. Besides further developing the computational framework, the PhD student is expected to cooperate with theoretical and experimental partners that wish to use this code in specific problems.

Requirements / Profile:

- Digital native with profound knowledge of Python
- General education in Optics and Photonics or Physics is mandatory
- Some exposure to theoretical and computational nanophotonics

Duration:

3 years

Salary:

E13 75%

Supervisor:

Prof. Dr. Carsten Rockstuhl (carsten.rockstuhl@kit.edu)

Document 4:

Title: "**Development of active metasurfaces for wavefront shaping and acoustic measurements**"

Description:

Metasurfaces are thin nanostructured layers that can manipulate light at will. It can revolutionize various technologies, including communication, imaging, sensing, and more. Their unique properties allow for unprecedented control over electromagnetic waves, leading to advancements in devices and systems that were once deemed impossible. Metasurfaces offer a high degree of tunability and customization. Researchers can design them to manipulate electromagnetic waves in specific ways, tailoring their functionality for diverse applications. This adaptability makes metasurfaces a versatile tool for solving complex engineering challenges. In this project, you will develop and test active optical metasurfaces whose properties can change on demand.

Responsibilities:

- Model optical metasurfaces using electromagnetic simulations
- Develop novel fabrication techniques for metasurface
- Perform experimental characterization and testing of fabricated devices

Requirements / Profile (preferred but not required):

- Background in electromagnetics, optics, and metamaterials
- Excellent problem-solving skills and ability to work independently
- Good communication skills, both written and verbal
- Basic experience in working at an optical laboratory.

Duration:

4 years

Salary:

75% of employment

Supervisor:

Dr. Maryna Leonidivna Meretska (maryna.meretska@kit.edu)