

## Speaker Karlsruhe Days of Optics & Photonics 2023



### **Abstract: Insights into the optoelectronic properties of perovskite semiconductors and opportunities and challenges in thermally evaporating these thin films**

Dr. Paul Faßl

Organic-inorganic metal halide perovskite semiconductors are a fascinating class of materials that hold great promise for application in solar cells, light-emitting diodes, lasers, photodetectors, sensors, and more. In the first part of my talk, I will provide an overview of their remarkable optoelectronic properties, which have led to a rapid increase in solar cell efficiency to over 26%, rivaling conventional silicon photovoltaics. I will then present

a theoretical framework for determining their internal luminescence quantum efficiency, a marker for the optoelectronic quality, by accurately quantifying photon recycling in perovskite thin films for the first time.

In terms of industrial applications, thermal evaporation of perovskite precursor materials is a particularly promising process that allows good control of perovskite composition and thickness over large areas. The crystallization dynamics of evaporated perovskite films are highly dependent on the choice of substrate material, and their optoelectronic quality still lags behind that of their solution-processed counterparts. However, a deeper understanding of the underlying mechanisms is still lacking. In the second part of my talk, I will provide an overview of the opportunities and challenges for thermally evaporated perovskite solar cells and discuss our current research focus.

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### Biography:

Paul Faßl studied Physics at Heidelberg University, where he graduated with a master's degree in 2013 and a Ph.D. in 2018. For his PhD, he received a research fellowship from the Heidelberg Graduate School of Fundamental Physics and a mobility fellowship from Heidelberg University for a research stay at Oxford University. His PhD thesis was entitled „Exploration of Properties, Stability and Reproducibility of Perovskite Solar Cells.“ In 2019, he joined the Next Generation Photovoltaics group of Prof. Ulrich Paetzold at the Light Technology Institute (LTI) and Institute of Microstructure Technology (IMT) at Karlsruhe Institute of Technology (KIT), where he has been working on the optoelectronic properties of perovskite semiconductors and the development of perovskite/silicon tandem photovoltaics. Since 2023, Faßl is a Group Leader at LTI/IMT focusing on the fundamental understanding and development of thermally evaporated perovskite solar cells. His group is involved in various German and European research projects on perovskite/silicon tandem photovoltaics.

### Statement:

I am pleased to provide KDOP students with insight into the remarkable optoelectronic properties of organic-inorganic metal halide perovskite semiconductors, which have fascinated me since the beginning of my PhD research. Furthermore, my current applied research on thermally evaporated perovskites gives the students a glimpse into the intersection between fundamental research and industry with the goal of low-cost and scalable fabrication of perovskite/silicon tandem solar cells.