Hybrid Solar Cells group (AMOLF)

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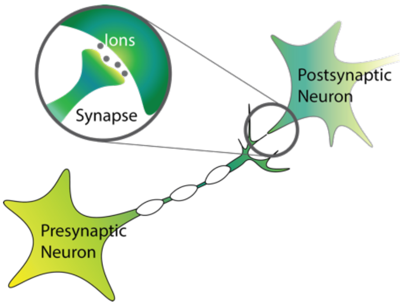
Research theme The *Hybrid Solar Cell group* is based at AMOLF in Amsterdam and is connected to the Photophysics and OptoElectronics group in Groningen. We focus on novel concepts towards more efficient solar cells using perovskite semiconductors. These materials are unique because they are both efficient semiconductors and ion conductors. Ion migration needs to be suppressed to make solar cells stable. We work on understanding and suppression ion motion, but also on new devices, artificial synapses, that use the unique ion migration for new functions.

Project 1. Ultralow energy consumption artificial synapse from halide perovskites

Supervisors: Jeroen de Boer and Bruno Ehrler



Halide perovskites are semiconductor compounds that are not only excellent conductors of electrons, but also of ions. This allows for entirely new applications, for example artificial synapses. These artificial synapses could work with an energy consumption that is comparable to that of biological synapses. In this project you will downscale these artificial synapses to the nanoscale and optimize the different layers in the device. The goal is to be able to finetune key properties of the synapses such as switching speed and retention time. This would enable the fabrication of dense, brain-inspired neural networks of artificial synapses for ultra-low power computation.

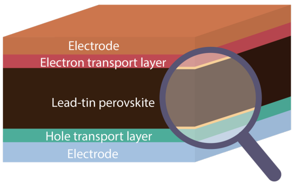
Project 2. Looking at the interface in a perovskite solar cell with a microscope

Supervisors: Moritz Schmidt and Bruno Ehrler

Solar cells based on halide perovskites are efficient, but poor stability is still one of the main bottlenecks on their way to commercialization. One of the contributing factors to the stability issue is mobile ions and ion vacancies that migrate within the perovskite. To further complicate things, illumination of the perovskite layer creates more mobile ionic species. In this project, you will study the impact of mobile ionic carriers on the device physics of perovskite solar cells. The focus will be on how illumination changes their density and diffusion coefficient. Next to device fabrication, you will focus on electrical spectroscopy techniques like impedance spectroscopy, transient capacitance, and current-voltage characterization. If desired, the project can also contain a part focusing on drift-diffusion simulations of perovskite solar cells.

Project 3. Study of interfaces in lead-tin perovskite solar cells

Supervisors: Daphne Dekker and Bruno Ehrler



To turn a perovskite into a fully functioning solar cell, it is sandwiched between a hole and an electron transport layer. What goes on at the interfaces between them is not fully understood yet. This project focuses on mixed lead-tin perovskite solar cells, that are needed for all-perovskite tandem solar cells. However, lead-tin based perovskite solar cells struggle with stability and degradation issues. To solve these issues, it is crucial to understand the contribution of the interfaces to the performance and stability of the solar cells. This project entails fabricating perovskite solar cells in a lab, using a state-of-the-art robot, and performing electrical measurements to examine their performance. Additionally, material characterisation and different types of spectroscopies will be performed to study the interfaces more directly.