

Tracking charge, spin and light polarization in space & time in emerging semiconductors

Prof. Sascha Feldmann

Tenure-Track Assistant Professor in Physical Chemistry & Head of the Laboratory for Energy Materials
Ecole Polytechnique Fédérale de Lausanne, Switzerland

SCR Member, Winthrop House
Harvard University, USA

sascha.feldmann@epfl.ch

Solution-processable semiconductors such as halide perovskites and certain molecules are promising for next-generation spin-optoelectronic applications [1]. Yet, we don't fully understand what mechanisms govern charge, spin and light polarization in such emerging energy materials, and even less how these are affected by chirality [2].

In this talk, I will give an overview of our recent efforts to understand the spin-optoelectronic performance of these materials through time-, space- and polarization-resolved spectroscopy and microscopy, and how these insights may enhance the performance of solar cells and other energy conversion applications.

For investigating halide perovskite films, we pushed broadband circular dichroism to diffraction-limited spatial and 15 fs time resolution for creating a spin cinematography technique to witness the ultrafast formation of spin domains due to local symmetry breaking and spin-momentum locking [3].

I will then briefly explain the fundamentals and artefacts involved in measuring circularly polarized luminescence reliably and introduce an open-access methodology and code to do so [4]. Finally, I will show our most recent development of a transient sensitive broadband full Stokes-vector spectroscopy with unprecedented time- and polarization resolution to track the emergence of chiral light emission [5].

[1] Nature Reviews Materials 8, 365 (2023).

[2] Nature Reviews Chemistry 9, 208 (2025).

[3] Nature Materials 22, 977 (2023).

[4] Advanced Materials 35, 2302279 (2023).

[5] Nature 643, 675 (2025).