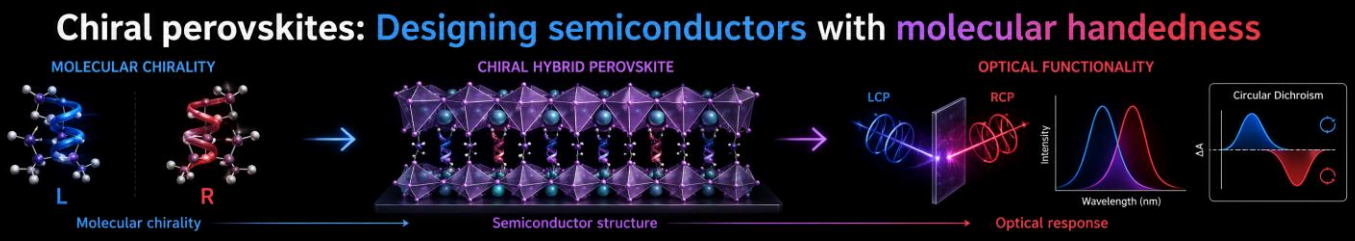
Master Thesis Project

Chiral perovskites: Designing semiconductors with molecular handedness

How does structural chirality modify the interaction between light and emerging perovskite semiconductor materials?



Research area: Chiral Materials | Functional Materials | Nonlinear Spectroscopy | Material Characterization
Scientific motivation: Chiral hybrid perovskites represent a new class of functional semiconductor materials in which molecular organization can be used to control optical and electronic properties. Unlike conventional semiconductors, these materials combine the outstanding optoelectronic characteristics of perovskites with the unique ability of chiral structures to interact selectively with polarized light. The origin and control of chirality in these materials remain fascinating open questions. How does molecular handedness influence crystal structure, electronic states, and optical responses? Understanding these relationships is essential for developing future materials for photonics, optoelectronics, and quantum technologies. In this project, you will investigate how molecular design and material structure determine the optical properties of chiral perovskite thin films.

Research question: How does structural chirality modify the interaction between light and emerging perovskite semiconductor materials?

Your project and the skills you will develop: During this Master thesis, you will investigate how molecular structure and organization determine the optical properties of chiral hybrid perovskites. By combining controlled thin-film preparation with linear and nonlinear optical spectroscopy, you will explore how chirality is transferred from the molecular building blocks to the semiconductor structure and ultimately expressed in its interaction with light.

During your thesis, you will:

- Prepare and characterize chiral perovskite thin films
- Investigate how molecular components influence material structure and optical properties
- Perform linear and nonlinear spectroscopic measurements to study light–matter interactions
- Analyze optical data and establish structure–property relationships
- Develop an understanding of how molecular design can create new semiconductor functionalities

You will gain hands-on experience with techniques including:

- Synthesis and fabrication of Perovskite thin films
- Circular dichroism (CD) spectroscopy
- UV/Vis and infrared spectroscopy
- Second Harmonic Generation (SHG) spectroscopy
- Structural and optical measurements and data analysis

The project offers the opportunity to work with advanced experimental methods at the interface of physical chemistry, materials science, and optical physics and is suitable for students in **Chemistry | Physics | Materials Science.** Previous experience in spectroscopy or materials synthesis is helpful but not required. Motivation and curiosity are most important.

Interested? For more information contact: PD. Dr. Aras Kartouzian | aras.kartouzian@tum.de