Organic Light for Sustainable Future

Project description

Can we make light-emitting devices that are more sustainable, flexible, and even biocompatible? This project explores organic light-emitting electrochemical cells (LECs) —a type of thin, printable light source made from abundant, non-toxic materials. Unlike conventional silicon-based technology, these devices can be lightweight, flexible, and environmentally friendly. But there's a catch; LECs behave in ways that are still not fully understood. Inside the device, ions and electrons move together and interact, and that interaction is what creates light. Understanding this process is the key challenge—and opportunity—of the project.

You'll join an active research group and choose between two research directions:

Track A — Freezing Ion Motion: capturing "snapshots" of the device operation

Electrons move fast. Ions move slowly. By measuring fast enough, we can "freeze" the ions and isolate what's happening. You'll work with a custom-built measurement setup to explore how these devices actually operate, combining experiments (IVL, spectroscopy techniques…) and drift-diffusion simulations to link observations to real physical processes.

Track B — Light Meets Matter

What happens when light is trapped between mirrors? It can strongly interact with the matter filling the space between the mirrors and form a new hybrid state called a polariton—something between light and matter. Our group recently demonstrated this in LECs for the first time. You'll help push this further by testing new materials and device designs, exploring whether this effect can improve efficiency and performance.

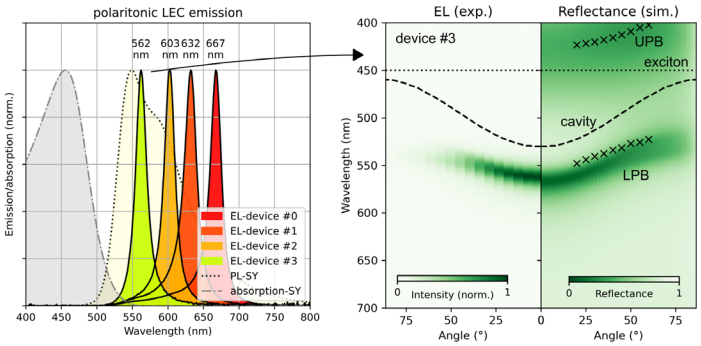

Figure 1. Polariton emission confirmation using different experimental characterization and modelling techniques.

Both tracks address the same big question: How can we design better light-emitting devices by truly understanding the underlying physics? The student will gain hands-on experience in thin-film device and optical cavities fabrication, optoelectronic characterization, optical spectroscopy, and the physics of light-matter interaction. No prior experience with LECs is needed.

Research group/environment

The project is hosted by the Organic Photonics and Electronics Group (OPEG) at the Department of Physics, Umeå University, a group of 12+ researchers working on sustainable organic electronics and photonics within the WISE framework.

To be conducted at: Department of Physics, Organic Photonics and Electronics Group

Level: A (Master, 30/45/60 hp/ECTS depending on program)

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