

Master thesis

Solar-Driven Photocatalytic Upgrading of Heteroatom-Rich Pyrolysis Oils

Plastic pollution and resource scarcity are major global problems and the demand of sustainable recycling strategies that can operate efficiently with hard-to-process mixed plastic waste is increasing. Pyrolysis, which converts plastic waste into oil and gas, appeared as a worthy technology that has already reached advanced TRL, albeit current practice is energy-intensive and poorly selective, producing heteroatom-rich oils that prevent direct valorization without prior, costly, and energy-demanding upgrading.

The EUCOR-funded PYROSOL project brings together complementary expertise in thermal pyrolysis (KIT), materials science (UHA), and photocatalysis (Université de Strasbourg). It focuses on the solar-driven upgrading of heteroatom-rich pyrolysis oils via photocatalytic dehalogenation and selective conversion into value-added products. This integrated approach aims to establish a sustainable and energy-efficient route for improving the quality and usability of pyrolysis-derived oils. The master's thesis will be carried out within the framework of this collaborative project with the following objectives:

- ◆ Establish and optimize analytical methodologies for tracking the concentration of heteroatom-containing organic compounds, particularly chlorinated species, in model pyrolysis oil using gas chromatography.
- ◆ Assess the catalytic performance of a range of photocatalysts in the upcycling of model pyrolysis oil, targeting both dehalogenation and photoconversion into value-added target products.
- ◆ Systematically investigate the effect of various reaction conditions on the photocatalytic valorization efficiency of benchmark photocatalysts.

The master's student will be hosted by the 'Photocatalysis and Photoconversion' team at the Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES), Strasbourg. The team will provide scientific guidance and hands-on experience on photocatalyst synthesis and characterization, advanced photoreactors, and analytical tools. In addition to the writing of a clearly-documented Master's thesis, the results will be presented in Karlsruhe as part of an ITC seminar on high-temperature process engineering, and at ICPEES in Strasbourg as an internal seminar.

The master's student will benefit from a monthly grant of about 680 € (free of taxes) to cover living expenses in Strasbourg.

For more information and application, please send a CV and contact Dr. Nicolas Keller (nkeller@unistra.fr and jonas.vogt@kit.edu).

Requirements:

- ◆ Enrolled student in a master's program in chemical engineering or a comparable field
- ◆ Interest in experimental work in the field of catalytic processes and analytics
- ◆ Lab work experience



Start of work: To be decided in agreement with the supervisors

Supervisors: Dr. Nicolas Keller (ICPEES-UNISTRA)

M.Sc. Jonas Vogt (ITC-KIT)