

Master's/Bachelor's Thesis

Bio-Based Humidity Sensors for Sustainable Applications

Flexible and printed electronics is revolutionizing healthcare, diagnostics, and environmental monitoring, driving urgent demand for biocompatible, and sustainable sensing platforms. Melanin, as a naturally derived pigment with intrinsic hygroscopic and redox-active properties offers a promising pathway toward truly sustainable electronics that can integrate seamlessly into living spaces and on human skin without toxicity concerns. Recent work has demonstrated that inkjet-printed melanin films, enhanced with biocompatible ionic additives, deliver competitive humidity. This project aims to systematically engineer melanin humidity sensors by optimizing salt chemistry to tune sensor sensitivity across specific humidity windows. The objectives focus on correlating deliquescence properties with impedance response, establishing design rules for application-specific sensors, and validating long-term stability for real-world deployment.

Advisors:

Prof. Dr. Gerardo Hernandez-Sosa
M.Sc. Fatemeh Etehadi

Research Field:

Eco-friendly and Printed Electronics

Work Place:

Campus North, IAI (Bldg. 445)
Practical work in Laboratory

Education, Experience, and Skills:

- Interest for Research
- Background in Physics, Chemistry, Material Science, Electrical or Mechanical Engineering

Language(s):

English

Starting date:

As soon as possible

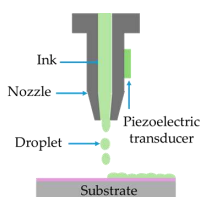
Duration:

3-6 month (depending on your program)

For more information, please contact:

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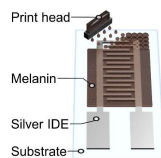
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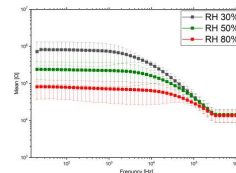
Inkjet working principal.



Inkjet printer Pixdro LP50.[2]



Inkjet-printed melanin onto a silver interdigitated electrodes.[1]



Impedance vs Frequency in different relative humidities for melanin-based printed humidity sensors.

Key Tasks:

- Formulate and optimize a systematic panel of melanin inks incorporating choline salts and biocompatible alternatives (ChCl, ChBit, ChAc, KCl, NaCl, MgCl₂, CaCl₂).
- Fabricate the flexible humidity sensors (including the interdigitated electrodes and the sensing area) using the ink-jet printing technique.
- Conduct impedance spectroscopy characterization (10–80% RH) and correlate deliquescence relative humidity (DRH) with sensor sensitivity, response time, and hysteresis.
- Execute humidity cycling studies; assess salt leaching, film stability, and recrystallization behavior via SEM and optical microscopy.

If you are interested, please send us your application via email (Fatemeh.Etehadi@kit.edu) including your current transcript of records and CV.

[1] ACS Appl. Mater. Interfaces 2024, 16, 32, 42555-42565

[2] <https://www.suss.com>