Master Thesis: Development of a Micro-Droplet Deposition Device based on Scanning Probe Lithography

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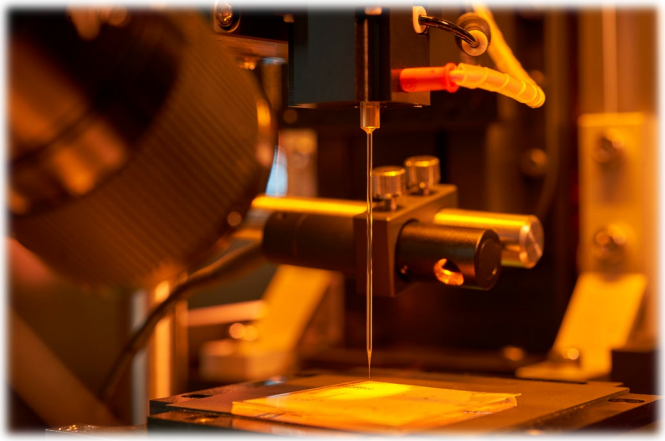

In recent years, there has been growing interest in advanced micro- and nanofabrication methods that enable the precise positioning of functional materials with high spatial resolution. Among these approaches, scanning probe lithography (SPL) has emerged as a versatile platform for direct-write patterning, offering unique capabilities for the deposition and structuring of materials at the micro- and nanoscale. Unlike conventional lithographic approaches, SPL employs a sharp probe to locally deliver material or induce surface modification, enabling flexible fabrication under ambient conditions and with minimal material consumption. Applications range from nanoelectronics and biosensors to functional interfaces and advanced materials research.

This project aims to extend an existing scanning probe lithography platform by developing a dedicated micro-droplet deposition device. The goal is to exploit the precise positioning capabilities of the established SPL setup while enabling controlled dispensing of liquid droplets in the micro-scale regime by microfluidic systems. The system will provide a flexible route for localized functionalization of devices, and diverse material deposition over larger areas, therefore broaden the range of accessible applications beyond conventional SPL processes.

The developed device will be designed, integrated, and experimentally evaluated. Particular emphasis will be placed on achieving reliable droplet generation, synchronization with the existing positioning system, and characterization of the resulting deposition process.

Tasks:

- Design and development of a micro-droplet deposition module compatible with an existing SPL setup.
- Integration of the deposition system into the existing hardware and software environment.
- Experimental evaluation and optimization of droplet formation and deposition behavior.
- Characterization of deposited structures and process reproducibility.
- Exploration of potential applications for localized material deposition and device functionalization in printed electronics.

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