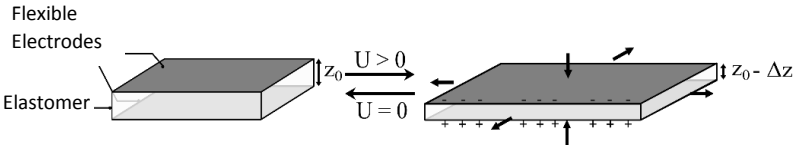
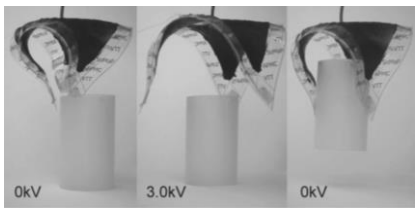
Fakultät Elektrotechnik und Informationstechnik, Institut für Halbleiter- und Mikrosystemtechnik

Study-/Diploma-/Master-Thesis

Topic: Inkjet-printing of flexible electrodes for soft robotics

Overview: Inkjet printing is a widespread printing technique characterized by fast, simple and purely additive production of small to large-scale printed images without using stamps or masks. In these matters, inkjet printing has the advantage over other printing methods.
In electronics, a variety of inks can be printed on a variety of substrates for the production of printed conductors, resistors and pads. Besides dissolved conductive polymers (e.g. PEDOT:PSS), metal nanoparticle-based inks (e.g., silver, gold, and copper nanoparticles) are used because they provide high conductivity upon thermal sintering.
For the production of flexible electrodes, a high and reproducible stretching behavior up to the percolation threshold and tear resistance are essential. Conventional inks usually fail here. Bonded carbon particles (e.g. carbon black, carbon nanotubes or graphene) deposited in layers on elastomeric films, with sufficient concentration, alignment, and surface adhesion, can meet these requirements.
Soft polymeric robots can be applied for artificial muscles, valves and even touch displays. To operate these robots electrically flexible electrodes are needed. By setting up a capacitor like stack of electrode, elastomer and electrode, an electronic electroactive polymer actuator is generated which is able to deform by charging the electrodes and can be utilized for robotic applications.





G. Kofod, W. Wirges, M. Paajanen, S. Bauer, Appl. Phys. Lett. 2007, 90, 89.

Objectives: Inkjet-printing of carbon-based inks on silicone elastomer membrane for flexible electrodes and set up a dielectric elastomer actuator for soft robotics.
Sub-tasks:

- Literature research of carbon particle-based inks (commercially available or self-made).
- Applying carbon particle-based inks for inkjet-printing.
- Investigation and adaption of elastomers surface properties for ink wetting.
- Generation of various print images and test patterns (e.g., area, number of printed and stacked layers, printing direction, speed, and temperature) and their validation with respect to resolution, conductivity, yield strength, roughness, stability and substrate adhesion.
- Setting up and characterization of a test actuator (soft robot).

Beneficial skills in:

- Microsystems and Materials Engineering
- Dealing with chemicals

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