Karlsruher Institut für Technologie

Laboratorium für Elektronenmikroskopie

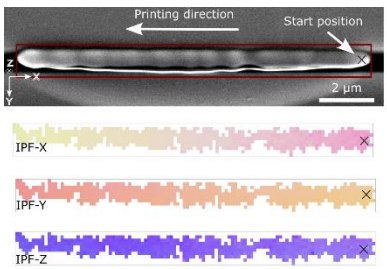
Masterthesis

Electron backscatter diffraction of photothermal laser printed rotating ZnO single crystals

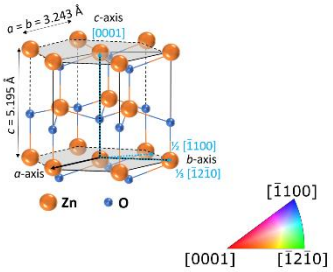
Motivation

The field of multi-photon 3D laser printing of polymers has revolutionized the production of intricate micro- and nanoscale architectures. Recent breakthroughs extend this technology to inorganic materials, such as single-crystalline ZnO, enabling the fabrication of functional microelectronics and circuits without post-processing. This research explores photothermal laser-induced ZnO printing, showcasing sub-micrometer structures and opens new avenues for developing functional microelectronics. This innovative approach opens opportunities for interdisciplinary master's theses, focusing on the crystallographic characterization of the ZnO using electron microscopy.

The different printed geometries are examined with regard to their size, shape, microstructure, crystallinity, crystal orientation, and crystal rotation. Therefore, state-of-the-art electron microscopy (EM) techniques (such as SEM, HRTEM, and STEM) are applied throughout the project. To analyze the crystal structure electron backscatter diffraction (EBSD) is performed on the preprepared ZnO crystals. In this process, electrons diffracted from the prepared ZnO surface. Resulting diffraction patterns are recorded, analyzed, and compared with simulation to characterize the crystals.



SEM image, and IPF maps of ZnO crystal line



Schematic hexagonal ZnO lattice and color legend for IPF maps

Tasks

- Familiarization with electron microscope (SEM, TEM) and FIB (Focus Ion Beam) sample preparation technique
- Microstructural characterization (shape and sizes different geometries)
- Crystallographic characterization (crystallinity, crystal rotation & orientation) by performing EBSD

Timeline

- 1st-2nd month: literature review and sample preparation using FIB
- 3rd-5th month: SEM introduction and performing EBSD investigation
- 6th-7th month: analyzing results and thesis writing

(for physics master students: additional TEM experiments)

Research area:
Microstructural and crystallographic characterization, single crystals

What you will learn:
Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Focused Ion Beam (FIB)

What you bring:
Master student in materials science or bachelor/master student in physics, basic knowledge in solid state physics

Starting date:
Beginning/mid of 2025

Language:
English or German

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