Focused Ion Beam

The FEI Strata 400S and the Zeiss Auriga 60 Dual Beam FIB are both a combination of a scanning electron microscope (SEM) and a focused ion beam (FIB) system, which allows imaging and structuring of materials at the nanoscale. The focused gallium ion beam can either be used for ion imaging or to cut predefined patterns or images in the surface of a solid. At the same time, the SEM can be used to image the nanostructures generated by FIB. In addition, it is possible to locally deposit C, Pt or W from precursor gases using the electron or ion beam. Additionally, Insulator Enhanced Etching (IEE) using XeF_2 is available.

Using this combined approach it is possible to

- **perform cross-sectional structural analysis of surfaces**
- **extend the cross-sectional analysis by slice and view techniques to image a complete 3D volume**
- **pattern surface at the nanoscale**
- **electrically contact selected structures on a sample**
- **target preparation of TEM samples and in-situ lift-out**

Contact

See KNMF website or contact the KNMF User Office.

Features

FEI Strata 400 STEM

- Electron Optics
  0.8 nm at 30 kV STEM
  1.0 nm at 15 kV SEM
  1.9 nm at 1 kV SEM
  Voltage 200 V–30 kV
- Gallium Ion optics
  7.0 nm at 30 kV
  Voltage 2–30 kV
- Detection: TLD SE, ETD, BSE, STEM, CDEM
- Analytical: EDX
- Omniprobe 200 micromanipulator
- GIS for C, Pt and W deposition
  GIS for XeF_2 etched enhance
- Flip-stage

Zeiss Auriga 60

- Electron Optics
  1.0 nm at 15 kV SEM
  1.9 nm at 1 kV SEM
  Voltage 100 V–30 kV
- Gallium Ion optics
  2.5 nm at 30 kV
  Voltage 0.5–30 kV
- Detection: In-lens SE, ETD, EsB, 4QBSD, SESI, segmented STEM
- Analytical: EDX+EBSD
- Omniprobe 400 micromanipulator
- GIS for C, Pt, W and Si deposition
  Gas injection for charge compensation
- Vacuum transfer system

Materials

Depending on the material, typically a volume of up to 30 x 30 x 10 μm^3 can be removed in a reasonable processing time, volumes of up to 100 x 100 x 50 μm^3 are possible to remove.

Limitations/constraints

- Sample has to be a solid at RT and stable under vacuum conditions
- Maximum sample dimensions restricted to 5 cm diameter

Typical structures and designs

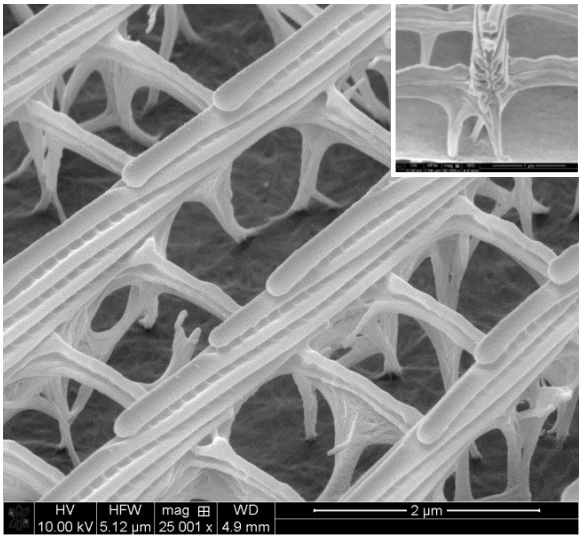

Fig. 1: SEM image of the photonic structures on a butterfly wing with a FIB prepared cross-section in the inset.
In collaboration with R. Siddique and R. Prang, KIT.

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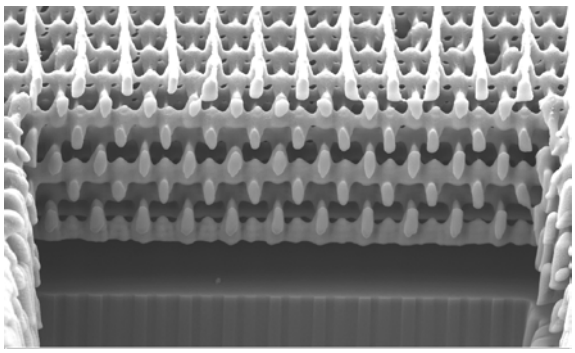

Fig. 2: Cross-sectional analysis of a photonic crystal generated by 3D direct laser writing.
In collaboration with NanoScribe and T. Scherer, KIT.

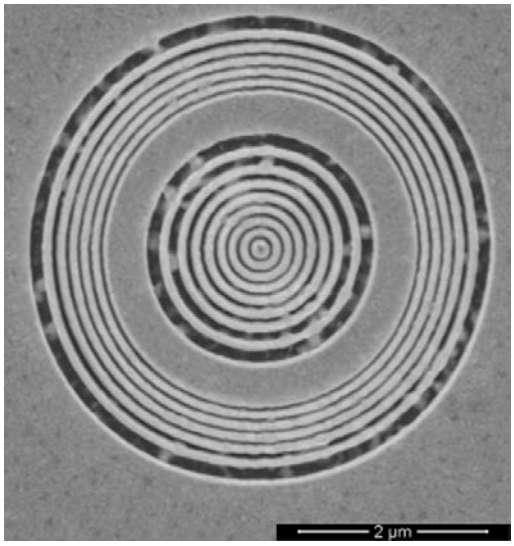

Fig. 3: FIB generated photonic structure in a thin gold film.
In collaboration with Y. Yu, IMTEK and D. Chaissing, KIT.

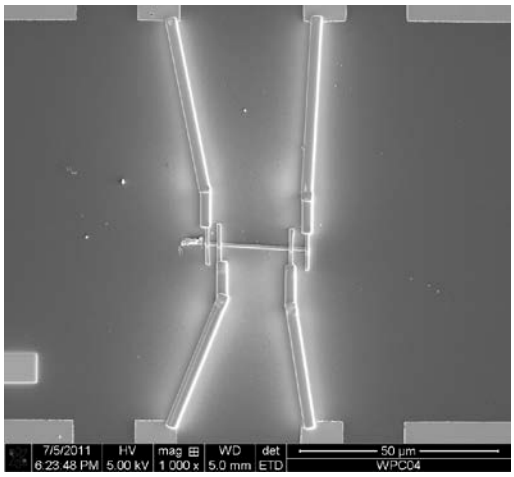

Fig. 4: Electric contacting of a silver nanowire for 4--point conductivity measurements.

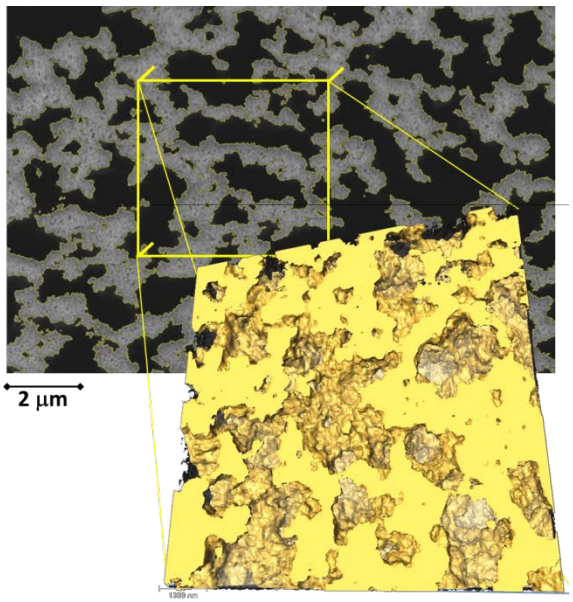

Fig. 5: 3D nanoscale morphology analysis of micro- and macroporous silica for application in HPLC: segmented digital slices through the 3D volume and volume rendering of a small area.
In collaboration with D. Stöckel, B. Smarsley, Univ. Gießen and C. Kübel, R. Prang, KIT.

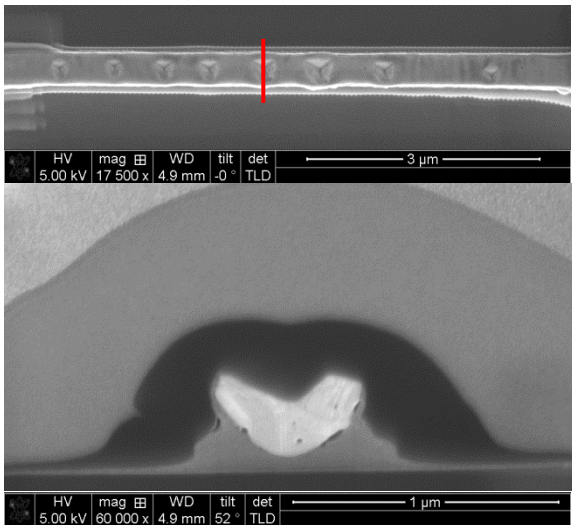

Fig. 6: TEM cross-section target preparation of a nanoindent in an Ag nanowire.
In collaboration with A. Kobler, T. Beuth and R. Prang, KIT.

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