

Group of Electron Beam Lithography

Department of New Technologies



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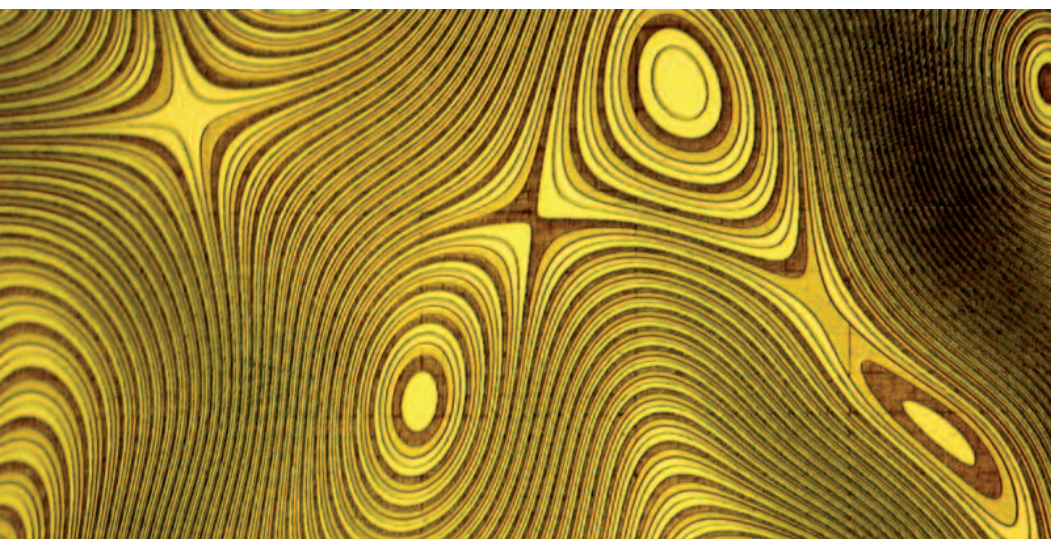
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Example of a general Fresnel structure

THEMATIC RESEARCH FOCUS

Research area

Electron beam lithography

Excellence

Variable-shaped e-beam writer
Diffractive optically variable image devices (DOVIDs)

Mission

Planar micro- and nano-structures prepared by e-beam lithography

DEVELOPED TECHNOLOGIES

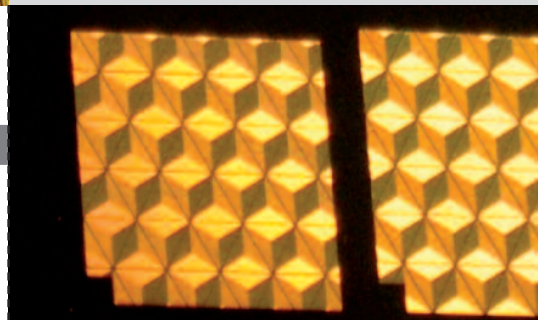
Content of research

- Variable-shaped e-beam pattern generator
- E-beam lithography using shaped beam writer and Gaussian beam writer
- Electron emitter preparation and characterization
- Optical diffractive, Fourier and Fresnel structures, DOVIDs
- Micro-sensors and calibration specimens

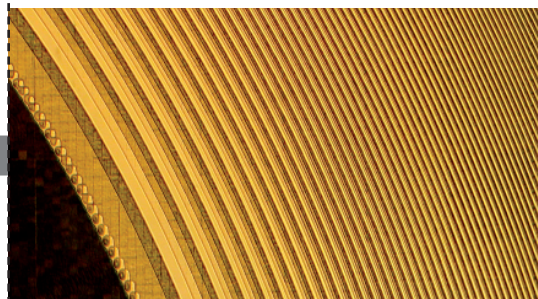
Main capabilities

Basic research

- Study and evaluation of electron scattering effects
- Electron emitter preparation and characterisation
- Calculation and optimization of computer generated holograms (CGH)

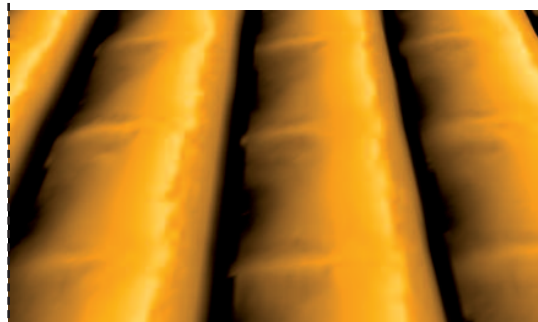


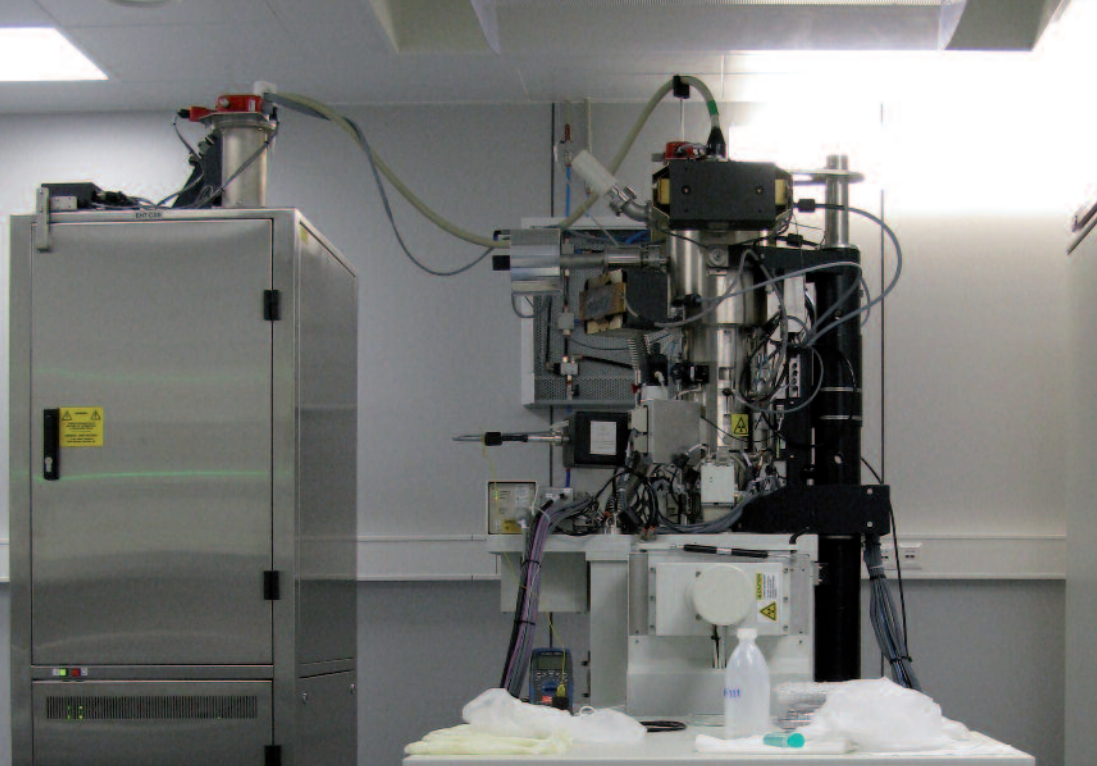
General Fresnel structure 20 x 20 mm²



Part of a Fresnel lens

Blazed grating (detail)





E-beam writer Vistec EBP5000plusES

Applied research

- Phase and amplitude computer generated hologram structures
- Diffractive optically variable image devices
- Electrochemical and biological sensors

Fields of research results application

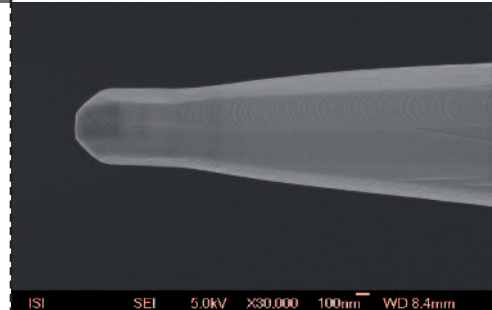
- Life sciences
- Materials science
- Measuring instruments
- Renewable energy
- Plastics, polymers
- Glass, ceramics

KEY RESEARCH EQUIPMENT

- E-beam writer (pattern generator) with shaped beam Tesla BS600
- E-beam writer with Gaussian beam Vistec EBP5000plusES
- Atomic Force Microscope (AFM) Pacific Nanotechnology Nano-R

ACHIEVEMENTS

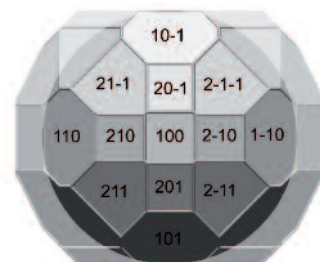
Electron-beam lithography group has been focused on the technological principles and the preparation of planar submicron-sized structures prepared in different solid state materials. Both the e-beam writer and the lithography technology was gradually developed. E-beam writer BS600 issues concern the improvement of resolution, writing speed, stability and appropriate source of electrons and proximity effect correction. Developed technologies led to very interesting results e.g. large-area diffractive structures, computer generated holograms, Fresnel structures, dimension calibration specimens, micro-sensors, special photolithographic masks and other structures used both for academic and industrial applications.



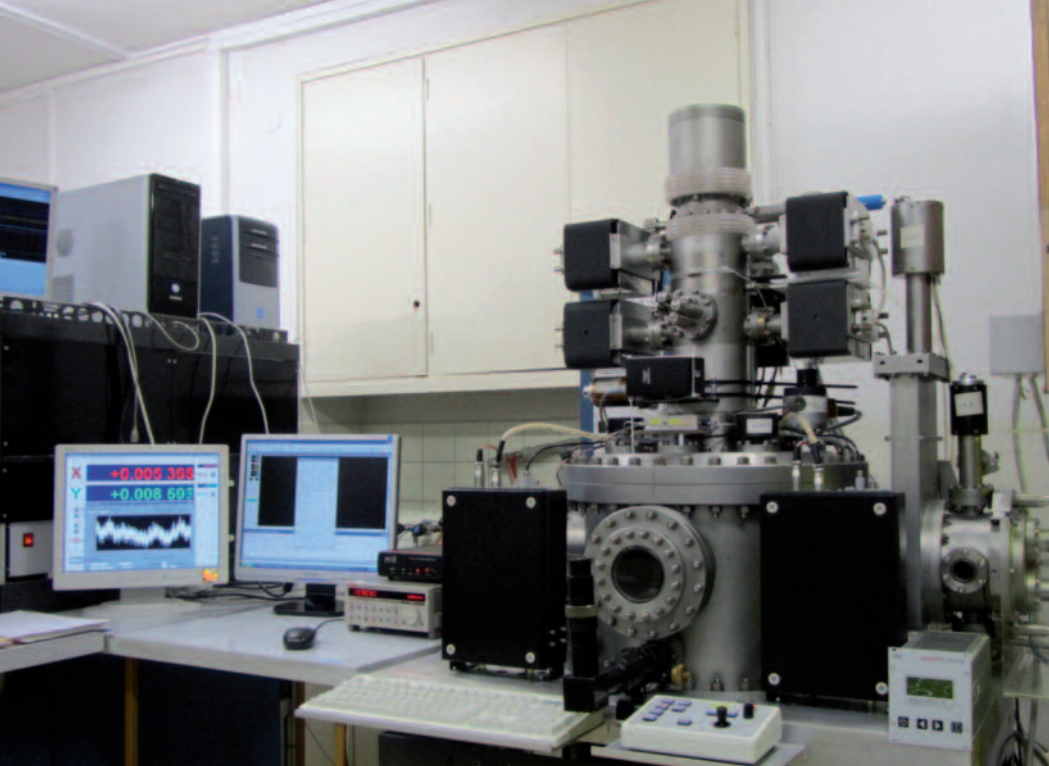
Electron emitter tip



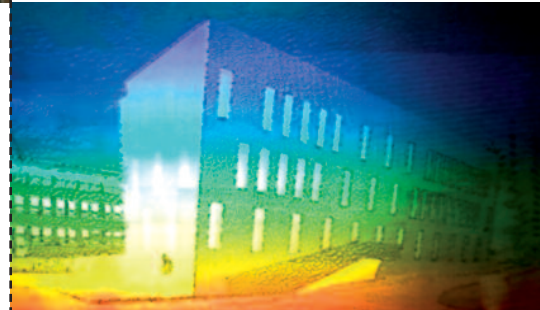
Emission pattern of the emitter tip



Model of the end form shape of the emitter tip



E-beam writer Tesla BS600



Simple diffractive image (ALISI building)

Scientific results

- Kolařík, V.; Horáček, M.; Matějka, F.; *Temperature monitoring of the EBL facility*. Electronic devices and systems 02 – proceedings, Brno, (2002), p. 207–210
- Daněk, L.; Matějka, F.; Kolařík, V.; Kokrhel, S.; Matějková, J.; *Non-diffractive submicron structures forming on electron beam lithograph BS601*. Proceedings – 7th Multinational Congress on Microscopy (MCM 2005), Ljubljana, (2005), p. 383–384
- Matějka, F.; Horáček, M.; Lencová, B.; Kolařík, V.; *Reducing the Size of a Rectangular-Shaped Electron Beam in E-Beam Writing System*. Proceedings of the 8th Multinational Congress on Microscopy, Prague, (2007), p. 87–88
- Matějka, F.; Horáček, M.; Kolařík, V.; Král, S.; *Modification of the Schottky Fe ZrO/W electron emitter*. Proceedings of the 12th International Seminar on Recent Trends in Charged Particle Optics and Surface Physics Instrumentation, Brno, (2010), p. 13–14

Application results

- Horáček, M.; Matějka, F.; Kolařík, V.; *Electron-Beam Writing System for Diffractive Optical Elements*. Pilot plant, (2006)
- Kolařík, V.; Matějka, F.; Horáček, M.; Lencová, B.; Matějka, M.; Král, S.; Urbánek, M.; Mikšík, P.; Vašina, J.; Horák, R.; *E-Beam Writing Technology with Variable Beam Size of 66–2100 nm*. Technology, (2009)

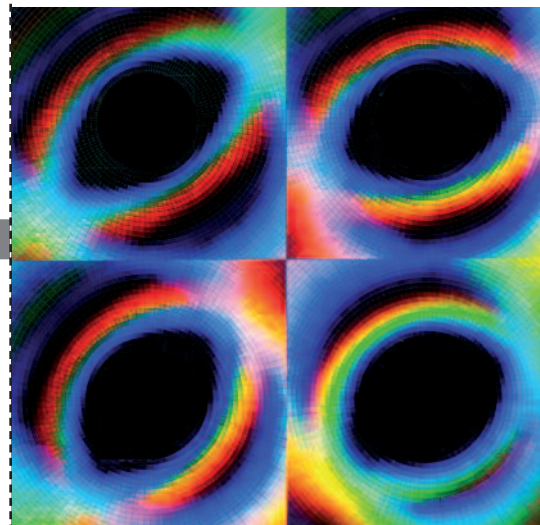
MAIN COLLABORATING PARTNERS

Collaboration with academic partners

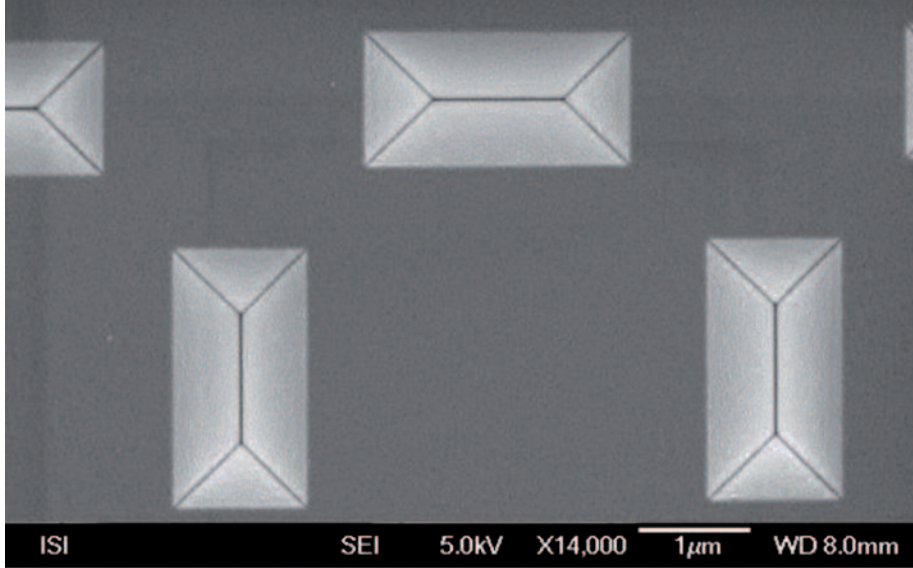
- Brno University of Technology (Brno, CZ)
- Masaryk University (Brno, CZ)
- Czech Metrology Institute (Brno, CZ)

Collaboration with companies

- Tescan (Brno, CZ)
- Optaglio (Řež u Prahy, CZ)
- FEI Czech Republic (Brno, CZ)
- Delong Instruments (Brno, CZ)



Diffraction grating sampler arranged as a segmented Fresnel lens



Grooves of a dimension calibration sample

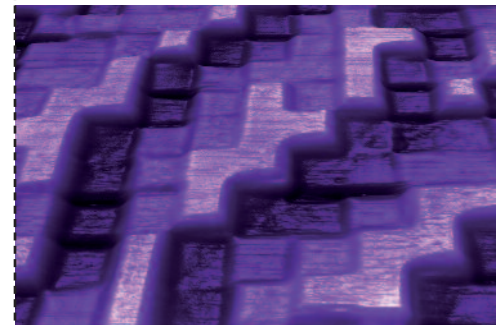
EXPECTATIONS

Offers

- Diffractive image structures
- Optical focusing elements
- Optical beam splitters, computer generated holograms (CGH)
- Photolithography masks
- Direct write lithography
- Dimension and material calibration samples

Requirements

- Collaboration with industrial partners on common projects dedicated to applied science
- New complementary technologies



Multilevel CGH structure



Laser beam forming on computer generated hologram (CGH) structures