pCVD diamond beam position monitors for PETRA III

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Outline

- Some news about “Diamond Materials”
- pCVD diamond beam position monitors for PETRA III
Fraunhofer IAF / Micronas

Fraunhofer IAF

Micronas GmbH
Low pressure deposition of diamond:
CVD: Chemical Vapor Deposition

$H_2, CH_4$

Microwave-Plasma

$T = 700 - 900^\circ C$

CVD Diamond
Synthesis

Isolated crystallites (nucleation)     polycrystalline plate
Proprietary deposition technology: P6
Ultraflat diamond windows

Planarity $\lambda/10$

Wavefront distortion $\lambda/5$

1.5” diamond windows
Superpolished diamond substrates

Peak to valley ±5nm
Ra < 1nm
Diameter 10mm
Nanocrystalline diamond films and plates

- Thickness 50nm to 50µm
- Roughness as low as 20nm
- Renucleation results in mirror grade surface finish
Polycrystalline diamond membranes
Polycrystalline diamond membranes

Unpolished > 50nm Ø: 1mm

Polished > 2μm / Ø: 10mm
Outline

• Some news about “Diamond Materials”

• \textit{pCVD} diamond beam position monitors for \textit{PETRA III}
PETRA III at DESY Hamburg
Fluorescence screens

... to get the beam into the beamline
... to align the beam
... to detect obstacles
... to examine the beam profile

Diamond Light Source
Fluorescence screens

... to get the beam into the beamline
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Diamond Light Source
pCVD diamond beam position monitors for PETRA III

diamond
... converts X-rays into visible light
... can handle high power
... is transparent

fluorescence detectors
CVD diamond fluorescence screens (measured at ESRF / ID6)

Fluorescence excited by a low power undulator beam (ESRF/ID6)

view of the camera
Get the beam into the frontend
Get the beam into the frontend
Get the beam into the frontend
Get the beam into the frontend
Get the beam into the frontend
Get the beam into the frontend
Get the beam into the frontend
Spectral fluorescence yield (measured at ESRF/ID6)

Screens for white and monochromatic beams

Luminosity strongly energy dependent
Quadrant detectors for X-ray synchrotron PETRA III

Idea:
Online beam monitoring as a feedback for X-ray mirrors
(Typical energies: 2.5-35 keV)
pCVD diamond quadrant detectors for PETRA III

quadrant detectors for beam monitoring

“solid state ionization chamber”
pCVD diamond quadrant detectors for PETRA III

- high quality pCVD diamond
- membrane supported by silicon ring
- open diameter: 10mm
- structured metallization (20µm gap)
- membrane thickness < 10µm

quadrant detectors for beam monitoring
X-ray absorption in diamond

40% absorption
2.5 keV X-rays
10µm diamond
Measurements at DIAMOND I24 Microfocus beamline

Photon Energy: 12.68 keV
Flux: $10^{12}$ ph/s
Beam size: 12x12 µm²
Velocity: 0.5s/step

500 µm gap
0.2mm stepwidth
Measurements at DIAMOND I24 Microfocus beamline

- 20 µm gap
- 2 µm stepwidth
- Photon Energy: 12.68 keV
- Flux: $10^{12}$ ph/s
- Beam size: 12x12 µm²
- Velocity: 0.5 s/step
Measurements at DIAMOND I24 Microfocus beamline

Photon Energy: 12.68 keV
Flux: $10^{12}$ ph/s
Beam size: 12x12 µm$^2$
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500 µm gap
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pCVD diamond beam position monitors for PETRA III
pCVD diamond quadrant detectors for PETRA III

single crystals?
„not yet“