

ESRF Motivation and Participation in 'CaraDD' FP7 Program

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The European Light Source

Access to diamond detectors for:

Synchrotron X-ray Beam Monitoring:

-diamond X-ray transparency (and thermal) properties -radiation hardness / low leakage current -single crystal material for X-ray 'optical' requirements

Microbeam Radiation Therapy (microdosimetry):

-near tissue equivalence -radiation hardness

Above based on multielectrode íonization-chamber' designs Multichannel electrometer or wideband readout electronics Characterization and testing of diamond material and devices:



Device and System level issues:

Device specification / design:

- multichannel electrode configurations
- non metallic electrodes
- simulation

— Fabrication and testing of contacted diamonds

Device mounting:

- low profile packaging and leadouts
- wideband (GHz) and multichannel (100+)
- high thermal load (>10W)

X-ray Microbeam dosimetry:

- absolute calibrations, tissue kerma mounting...

System level:

- signal processing electronics
- interfaces and software (test and end-user)



ESRF Preliminary Task - Timelines

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Task Name	2006	2007	2008	2009	2010	2011	2012	2013	2014
🖃 Material Characterization (by technique)				-		-			-
Bulk				-					L
🕀 X-ray Topography, ID19 and BM5					1111		1111	111	
Crossed polarization and other optical microscopy						i fu nastr su	1 (v 10 v 10		
🗆 Surface				-	-	-	-		-
Glancing angle (evanescent wave) X-ray diffraction					21	1			
Optical interferometry							-		
AFM									
Electron Microscopy and Cathodoluminescence									
Device Fabrication				-			-		-
conceptual design, CAD and device modelling									
Metal electrode devices								1	
Alternative electrode technologies (graphite, doped epi-growth layer)									
🖃 Packaging						-			-
diamond immediate packaging									
device mechanical mounting and leadout cabling techniques									
high thermal load mounting									
tissue kerma mounting (for X-ray microbeam dosimetry)									
🖃 Device characterization (by technique)				-			Here	-	-
Electron microscopy and electron beam induced current imaging									
Laboratory X ray microsource mapping									
🗄 X-ray microbeam map-imaging (ID21, ID22)					III				
High temperature response								-	
Application system level testing				-	2				-
electrometer current readout, multichannel design and fabrication									
RF readout techniques design and fabrication									
Application specific, user interface software development									
🖂 X-ray beamline test campaigns				*		-		-	-
performance; stability as monochromatic beam monitor									
performance; stability as white beam beam monitor									
MRT: cross calibration and absolute dosimetry; performance; stability									

'CaraDD' FP7 Preparation Meeting, GSI Darmstadt 25-26 June 2007

Slide: 5



Annual cost of a *thesis student* (inc. social charges etc.):

- Year 1:
 44k€

 Year 2:
 47k€
- Year 3: 50k€

Annual cost of a *Postdoctorate* (inc. social charges etc.):

- Year 1 & 2: 75k€
- Year 3: 78k€

"For FP7 RTD activities, ESRF assumes that it can claim 75% of real costs and 60% overheads"



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E-6 'electronic grade' CVD

White beam transmission (220 and 040) of E6 'electronic grade' diamond plates

MDS-1...5, ~3.6 x 3.6 x 0.35 mm³





Thinned sample 45µm

E6 Ascot sample after *scaife polish* at E6-Cuijk

Side 2 etched by carbiding braze alloy mounting



side 1

0.65nm rms

side 2



1.9nm rms

E6 sample MDS1 (thickness 350 µm, E6 resin wheel polish, *then scaife and 'superpolish' by J Butler-NRL*





PROMAP 512 profilometer-ESRF



XBIC mapping contacted diamonds

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ESRF beam 50ps pulses at 3nsec-3µs intervals, energy (ID21) 2 ... 7.2 keV

Fresnel zone plate focuses the X-beam to a *sub-micron* probe. Unwanted diffraction orders from the zone plate are removed by a central stop and an order selecting aperture (OSA).

+ near surface (~10 μ m) or bulk charge injection



ESRF-ID21 X-ray Microscope

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