

Discussion Trigger

X-ray pinholes technology

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Motivation

Elettra 2.0 beam instrumentation will include x-ray pinhole cameras

This is the 1st XPC designed in our group → no experience

SWR simulations → optimum for 10-15 micron pinhole width

We are currently beginning the pinhole design

We will appreciate if you could share your experience

Conceptual designs

- A) Two orthogonal stacks of tungsten plates with spacers that define the pinholes width
- B) Single lithographic high aspect ratio pinholes made from Au coated substrate
- C) Other ?

Transmission vs material and thickness

Q1: How do we define "enough" absorption of x-rays?

A (?): by matching the dynamic range of the camera at the max photon energy ?

Example.:

- Dynamic range 20000 (Hamamatsu Orca Fusion)
- Max photon energy e.g. = 30KeV

→ Transmission $T \leq 5e-5$ @30KeV. With CXRO this can be obtained by:

- Tungsten → 250 μm
- Gold → 200 μm
- Tungsten Carbide → 400 μm
- Molybdenum → 800 μm
- Iron → 1700 μm

Q2: Are there reasons to have an even smaller T ... ?

Material choice for x-ray pinholes

Pure tungsten vs tungsten heavy alloys vs tungsten copper alloys vs tungsten carbide

Tungsten Alloys are made of sintered powders ... any drawbacks?

	Pure Tungsten	MT-17C 90% W 6% Ni 4% Cu <i>Inermet</i>	MT-18C 95% W 3.5% Ni 1.5% Cu <i>Inermet</i>	W50/Cu50 50% W 50% Cu <i>(Metal matrix composite)</i>	W90/Cu10 90% W 10% Cu <i>(Metal matrix composite)</i>	WC Cemented	Mo	AISI 316
Density (gr/cm3)	19,3	17	18	11,8	16,7	15,6	10,2	8
Amagnetic	YES	YES	YES	YES	YES	YES	YES	YES
Hardness (HRC)	31	24	27	<20	26	>60	19	~25
Coef. Thermal Exp. x 10E-6/C	4,4	5,4	4,4	>10	7,9	5,2	5,1	16
Easier to machine than pure tungsten	/	YES	YES	YES	YES	NO	YES	YES

https://indico.cern.ch/event/68025/contributions/2066209/attachments/1023183/1456750/SlidesWKIemtp_Annecy_24909_final.pdf

Spacer Shape and materials examples

A few examples:

Shape	Material	Process	Thickness (μm)	Lab
Plates/Foils	Aluminum	Etching	15	Diamond
No spacer	Mo/W	/		Diamond
Wires	Tungsten	?	16	PAL
Plates/Foils	Silver, Copper		1.... 8, 9, 10, 15	Commercial
Wire	Tungsten		5,10,12,15	Commercial

2D lithographic gold pinholes with high aspect ratio

- Explored M.Gerner et al (Bessy 1998) and recently by N.Vitoratou, L.Bobb, IBIC 2022
- Gold thickness ~ 200 micron
- Less thickness → less need of angular adjustment
- Easier to characterize (less depth of field, easier illumination, SEM possible)
- Commercially available from <http://www.microworks.de>
- *but...disregarded by our MAC in favor of tungsten/spacer stack design ... ?*



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Thank You !