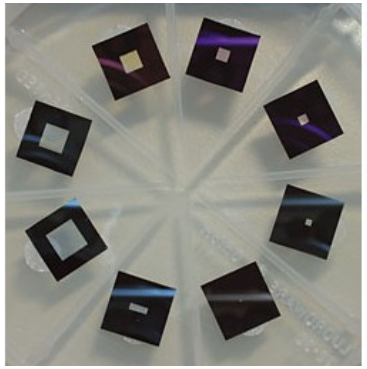
Progress with solid state detectors

1. Beam Monitoring Foils
2. Options
3. Status
4. SERENITY - update



Alex Howard

Beam Monitoring

- As mentioned last time – the idea:
  - very thin membrane made from AlN or SiN
  - coated with electrode arrays: position information/beam profile
  - Signal would be a **current** measurement induced on the electrodes
- Thickness of material only **50 – 150 nm**
  - **Choice of material means it can be quite flexible and even withstand 1 bar**
  - **Chemical etching facilitates achieving such thin wafers**
  - **However, still fragile if touched (like bursting a bubble)**
- I contacted two companies and received positive responses (silson, ametek)
- Cost seems ~ 100 – 300 GBP, depends on failure rate, thickness and diameter
- Some work required to define:
  - Electrode structure
  - Diameter
  - Thickness (i.e. pressure gradient)
  - Fixation – Gasket (window)? Glued? Inserted/free-standing?
  - Read-out scheme (connections, electronics)

Foil Manufacturers (1)

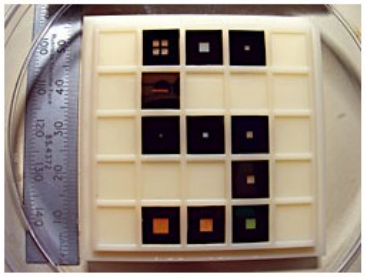
- Si3N4 material, probably etched
- Silson is a small UK company
- Rely more on a support frame (200μm), smaller area than hsfoils/ametek?
- http://www.silson.com/

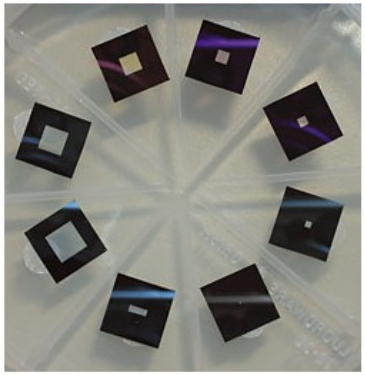
Silson

CONTACT US HOME

- > Standard windows
- > Multi-frame arrays
- > Large area windows
- > Multi-element windows
- > Windows for TEM
- > Bespoke service
- > MEMS Prototyping
- > Lithography wafers
- > Zone Plates & Lithographic Products
- > Microfluidic Cells

Since 1994, Silson Ltd has been supplying ultra-thin membranes and related lithographic products to Corporations, Universities and Government Research Laboratories throughout the world. Products are extensively used within the x-ray and e-beam communities but additionally Silson is now able to offer a MEMS prototyping service.





Standard silicon nitride membrane windows

The standard range of Silson silicon nitride membrane windows consist of square silicon nitride membranes in square silicon supporting frames. The standard frame sizes are: 5.0, 7.5 and 10.0 mm.

The default frame thickness is 200 µm but we are also able to offer the full range of membrane thicknesses on 381, 525 and now 100 µm thick substrate stock. The standard membrane sizes are: 0.25, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0 and 5.0 mm

The maximum membrane size within a 5.0 mm frame is 1.5 mm and the maximum for a 7.5 mm frame is 3.0 mm. Otherwise, the full range of membrane sizes is available within each of the standard frame sizes. The following range of standard membrane thicknesses is available: 30, 50, 75, 100, 150, 200, 500 and 1000 nm.

If your preferred design is not covered by the above permutations then we may able to help you with one of our other products.

Use the standard product finder to see if your preferred permutation is available. go

SILSON

- Size: 1 – 3 cm is a big difference and the price difference will be equally large so always go for the smallest window you can, it will be much more robust and cheaper
- Geometry: only easily make rectangular membranes
- Electrodes:
  - Normally Al, Au, Cr, Ni but many metals are available in-house
  - a few to a few hundred nm by e-beam evaporation gives the best quality films
- Request: details or a drawing of the electrode and any preferences for material

SILSON

- Have put 14.0 mm membranes into 17.5 mm frames and 19.0 mm into 23.5 mm
  - Depending on how they will be mounted you may need a wider frame.
- Can also mount membranes into free-issue mounts or we can design a mount to meet your requirements
  - Usually mount with low out-gassing epoxy.
- 1 atmosphere window at 10.0 mm the membrane needs to be 1000 nm thick
  - At 50 nm it’s down to 0.5 mm
- You can make windows from arrays of membranes but the transmission is then poor because of all the supporting ribs and if you make the ribs too narrow it is the ribs which break, e.g.:
  - a 100 nm thick, 10.0 mm membrane in a 14.0 mm frame is GBP 120.00.
  - a 50 nm thick, 10.0 mm membrane in a 17.5 mm frame is GBP 270.00.
  - lower yield per wafer by area:
    - the membrane is thinner, they break more - lower success per wafer.
- Metallisation increases prices by ~50%

Foil Manufacturers (2)

- Etched Si3N4 with outside support frame
- Very thin free standing (I believe), can withstand 1 bar
- Formerly hsfoils in Finland, now ametek

Specifications

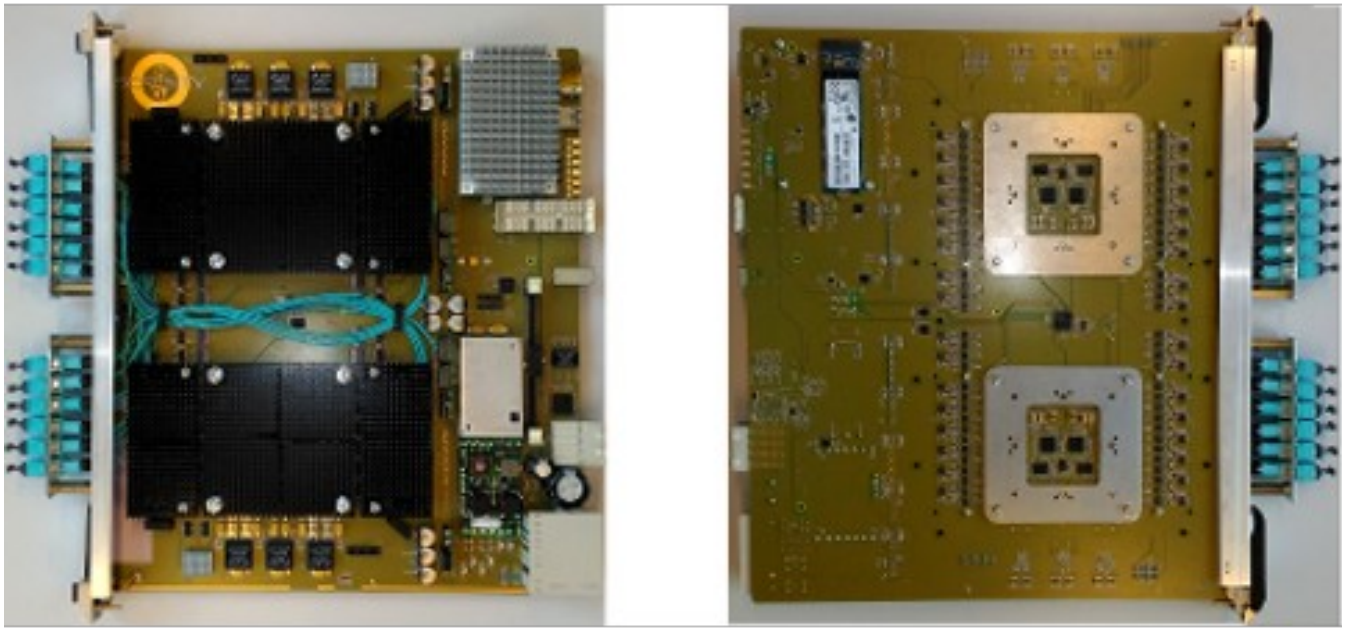
	C1	C2
Thickness (Si3N4)	150 nm	40 nm
Aluminum Coating (Grounded)	250 nm	30 nm
Window Diameter	6.3 mm	5 mm
Window Area	30 mm^2	20 mm^2
Grid Type	Hexagonal Si, 15 µm thick	
Open Area Grid	80%	80%
Helium Leak Rate	<1 x 10^{-10} mbar l/s	Do not put the C2 window into He purge !
Operating Temperature	-55°C to +150°C (0 bar pressure differential)	
	-40°C to +85°C (1 bar front pressure differential)	
Pressure Testing for C1 and C2 Windows:	1.6 bar front pressure differential for 10 seconds	
	10 cycles of 1 second duration with 1.6 bar front differential pressure	

AMETEK

- Have manufactured similar windows before (!)
- Feasibility, NRE, unit cost and possible timeline will depend on the details of the structure and other design parameters
- Key items are the diameter of the membrane and the structure of the electrode
- Need to follow up….

SERENITY

- V1.1: 72 x 2 firefly links can run at up to 28Gbps/link
- V1.2: 120 x 2 firefly links, less (6) interconnection between FGPAs
- 2 Daughter Card sites (custom FPGA)
- Carrier card with service FPGA and CPU + ZYNQ option (v1.2)
- ATCA, but adaptable form factor (e.g. rack/pizza box)



SERENITY

- Moving to a more concrete POC phase
- Looking for real applications/customers outside of CMS/HEP…
- Input for use cases, data rates, algorithms welcome!