

Specifications

Standard Reference Instrument Series 6006

Precision Micro-machined Apertures

Description: Precision micro-machined apertures are fabricated from silicon on insulator (SOI) wafers. Lithographic processing allows great flexibility in the aperture design, enabling precise placement of apertures, through holes, and chip outlines. Optionally, metal can be deposited for low emissivity. Multiwall vertically-aligned carbon nanotubes can be grown for high emissivity on chips containing through holes but no precision apertures.

Design, fabrication, and technical measurements leading to the production of this SRI were performed by N. Tomlin, NIST Applied Physics Division.

Support aspects involved in the issuance of this SRI were coordinated through the NIST Office of Reference Materials.

Specifications: Aperture design is subject to review to ensure it is possible to fabricate. See attached figure for sample aperture design. The side with the precision aperture is referred to as the front. The following design guidelines are recommended:

- Precision aperture:
 - Aperture thickness:
 - Options 6006a & 6006b & 6006h: 8 μm to 12 μm (typically 10.5 μm to 11 μm , but may not be able to specify, depends on SOI wafer availability)
 - Options 6006e & 6006f: 200 nm to 1000 nm (typically ~500 nm, but may not be able to specify, depends on design)
 - “Pullback” from edge behind aperture can only be a maximum of 2 μm to 3 μm (see example drawing below)
 - Aperture width: 10 μm to 5000 μm
 - Shape: rectangular, circular, more complicated shapes possible pending review
 - Minimum feature length/size: $\geq 10 \mu\text{m}$ (may be some rounding)
- Wafer/chip:
 - Length of longest line drawn between any 2 outline points: 63.5 mm (must fit on 76.2 mm diameter wafer)
 - Except for option 6006h (150 mm wafer) – design subject to review
 - Thickness: 300 μm to 600 μm (may not be able to specify, depends on SOI wafer availability)
 - Outline minimum feature size: $\geq 10 \mu\text{m}$ (may be some rounding)
- Backside channel width: 100 μm to 6000 μm (must be wider than aperture width)
- Through hole minimum feature size: $\geq 100 \mu\text{m}$
- Dimensions specified in metric units (millimeter or micrometer preferred)
- Option 6006b & 6006f & 6006h: metal coating on aperture/front side:

- Electron beam deposition
- Metal coverage: “blanket” front side, no patterning possible
- Metals available: Ag, **Al**, Au, Cu, PdAu, Pd, Pt, Ti, V (as of writing, depends on metal availability when purchased)
 - Standard is 2 nm to 5 nm Ti followed by 100 nm to 200 nm Al
- Metal thickness: 50 nm to 500 nm
- Option 6006g: vertically-aligned carbon nanotubes (VACNT) on one side:
 - Incompatible with precision aperture, compatible with through holes only
 - Si thickness: 300-500 μm (may not be able to specify, depends on Si wafer availability)
 - VACNT height: 20 μm to 200 μm (may not be able to specify, best effort)
 - VACNT coverage: blanket or specified area
 - VACNT growth may adversely affect through hole edges

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Standard Configurations:

- 6006a** Precision aperture(s), 8 μm - 12 μm thick aperture, no metal coating, 76.2 mm SOI wafer
- 6006b** Precision aperture(s), 8 μm - 12 μm thick aperture, metal coating on aperture/front side, 76.2 mm SOI wafer
- 6006e** Precision aperture(s), 200 nm - 1000 nm thick aperture, no metal coating, 76.2 mm SOI wafer
- 6006f** Precision aperture(s), 200 nm - 1000 nm thick aperture, metal coating on aperture/front side, 76.2 mm SOI wafer
- 6006g** Aperture(s), 300 μm - 500 μm thick through holes, vertically-aligned carbon nanotubes on one side, 76.2 mm SOI wafer
- 6006h** Precision aperture, 8 μm - 12 μm thick aperture, metal coating on aperture/front side, 150 mm SOI wafer

All Si dimensions and thicknesses are best effort basis and not guaranteed. Additionally, coating performance (e.g. reflectance, metal thickness, nanotube height) is best effort basis and not guaranteed.

Apertures (options a,b,e,f,g) are fabricated on a 76.2 mm (3 inch) diameter wafer, while aperture option h are fabricated on a 150 mm diameter wafer. If space allows, multiple copies of the aperture chip will be fabricated on one wafer.

The critical feature of the precision micro-machined apertures is the aperture width. The width will be inspected with an optical microscope, which has been calibrated against a NIST-traceable stage micrometer.

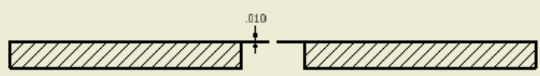
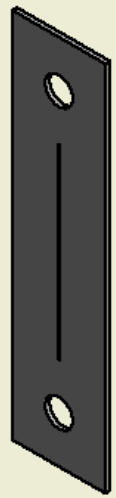
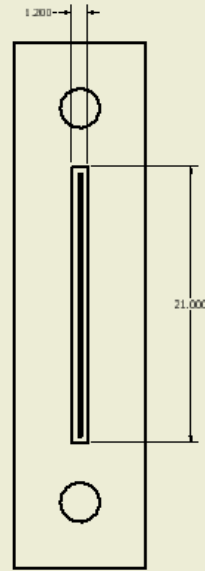
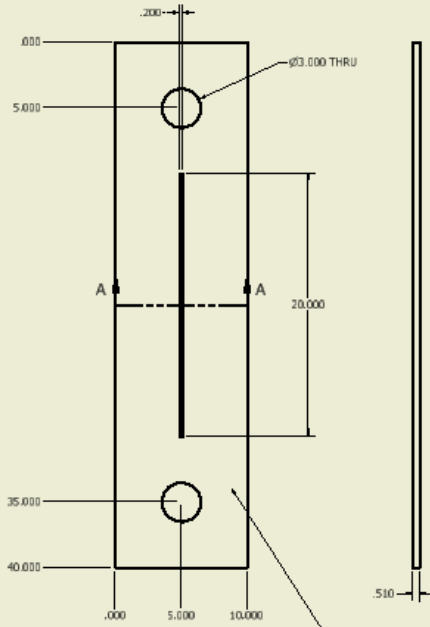
Customers will receive a detailed fabrication and calibration report along with the SRI.

Delivery and Shipping: NIST will prepare packaging for shipment of the SRI. Shipping costs will be included in each quote. Customers are responsible for all customs duties and import fees (HTC 9002.90.9500).

(sample drawing for option 6006b)

front side

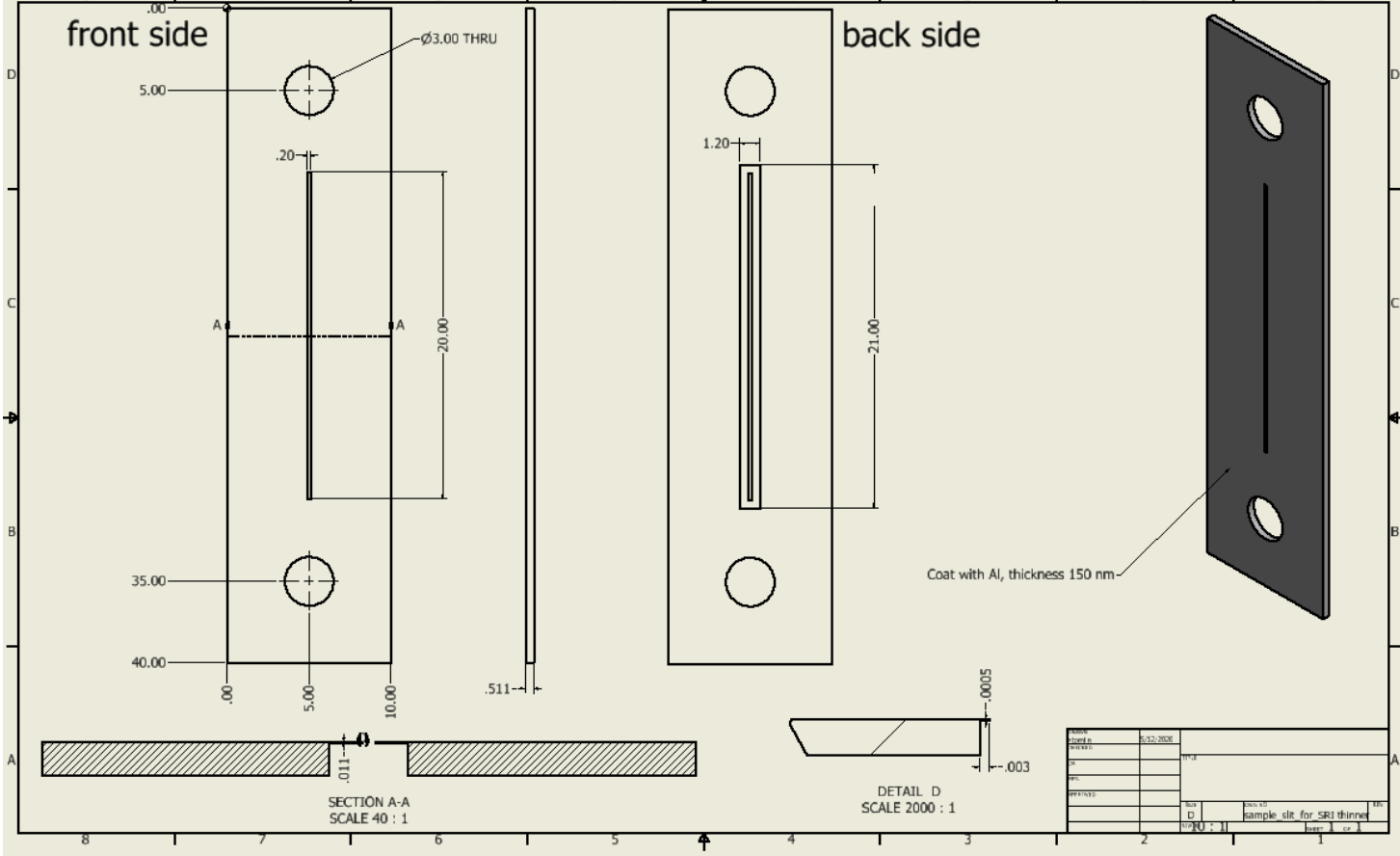
back side



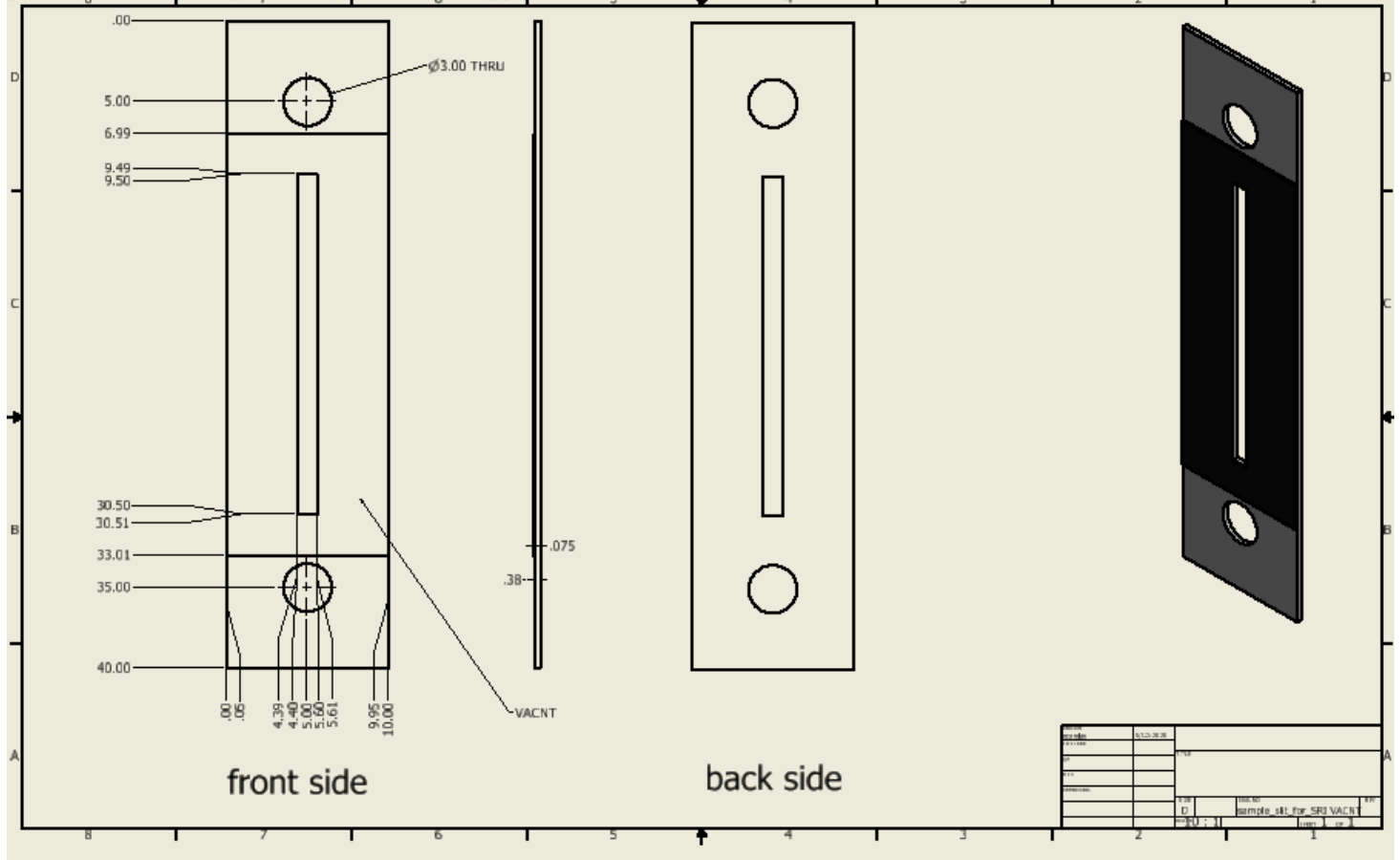
SECTION A-A
SCALE 20 : 1

DRAWN	2/9/2015	TITLE	
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QA			
MFG			
APPROVED			
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SCALE		sample_slit_for_SRI	
		SHEET 1 OF 1	

(sample drawing for option 6006f)



(sample drawing for option 6006g)



Users of this SRI should ensure that the Specifications Certificate in their possession is current. This can be accomplished by contacting the Office of Reference Materials: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/sri>.