

**Sole-source justification for purchase of special high-purity silicon material**

**Requested by:** Richard Jones, Dept. of Physics, University of Connecticut unit 3046.

**Vendor:** Sequoia Semi Tech, Inc.,  
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**Justification statement:**

This high-purity single-crystal silicon ingot is needed for the production of X-ray optics for diffraction experiments at the Cornell High Energy Synchrotron Light Source located on the campus of Cornell University, Ithaca, NY. High-purity silicon crystals of this size are produced by special industrial facilities in the form of a “boule”, or a solid cylinder of variable length, depending on the application, with the axis of the cylinder aligned with one of the principal crystal axes. The principal market for high-purity silicon is the manufacturers of electronic chips. These buyers are principally concerned with the electronic and thermal properties of the material. The requirements for high-quality X-ray optics are somewhat different. Because the X-ray optics market is very small, manufacturers of bulk single-crystal silicon tend not to be very specific about the properties of their product that are important to X-ray specialists, such as the large-scale uniformity or dislocation structure of the crystal. Therefore, the only cost-effective way to proceed is to buy material from a number of different manufacturers and measure the X-ray properties ourselves. My colleague Ken Finkelstein (CHESS Scientific Staff, user liaison for beamline C) has approved a particular sample for our application that is currently available in stock at Sequoia Semi Tech. The particulars of this piece are clarified in the correspondence between Ken and Mo Chen at Sequoia, quoted below. Our intention is to purchase this boule, and then as needs arise, cut off from it slices of various sizes and thicknesses to create the optical elements needed to carry out the X-ray measurements being supported under our research grant.

*[from K. Finkelstein]* Good morning Mo Chen,

We have now used some of the material you supplied to build a very sensitive x-ray monochrometer. It has worked very well! Thank you. Most of the remaining material has been cut (at various angles off the ingot axis) into thick sections that will be sliced into wafers and polished. Would you please inquire with your silicon suppliers to provide a quote for a 20cm long (approx. 100.8mm diameter) silicon ingot meeting the same specifications we have requested for the past order? If possible look for an ingot of relatively uniform resistivity (if possible 2 KOhm-cm), say within 10%, along the length. When you have found material, please send the quote to Professor Richard Jones at the Physics Department, University of Conn. The email address is: richard.t.jones@uconn.edu Please send me a copy of the correspondence. Based on \$800/Kg the cost would be about \$3K.

*[from Mo Chen]* Dear Ken,

My vendor was able to find the below ingot that fits your description. 4inch N-type FZ undoped, <111>

Axis resistivity: 1900~2000ohmcm

Center                      edge

1350      2050 2000 1900 2100 (top)

1300      2000 1800 1850 2000 (bottom)

Length: 190mm

Please let me know if the above will work for you. I will then proceed with a quote. Thanks.

Mo Chen, Sequoia Semi Tech

*[from Ken Finkelstein]* Mo Chen,

Since the ingot will be shipped to CHESS (me), and most likely used here, it makes sense that we (here) determine what material properties satisfy our needs. The purchase will be made through Professor Jones, so he needs to place the order with you. The ingot you list satisfies our requirements, but has a larger change in resistivity between center and edge, than for example the 189mm ingot (No. FN100.8A1010A-436-7) purchased from you recently. If it is easy to find an ingot with more uniform (and high) resistivity that would be preferred. Otherwise this one is OK.

Thanks you, Ken F

*[from Mo Chen]* Hi Ken,

Please check the two ingots below see if any of these meets your request:

Center                      Edge

1) 1870      2180 2200 2140 2340

2150      2560 2490 2510 2570

Length: 204mm

2) 1800      1850 1820 1910 1880

1820      1800 1850 1880 1810

Length: 189mm

Kindest regards, Mo Chen, Sequoia Semi-Tech, Inc.

*[From: Kenneth Finkelstein]* Mo Chen,

# 2 looks best for our application. I look forward to the quote.

Thank you, Ken F

*[From Mo Chen]* Hi Ken,

The price remains the same, \$800/kg, FOB San Jose, CA, lead time 3 weeks.

Fyi, the weight of this ingot is 4.514 kg.

Kindest regards, Mo Chen, Sequoia Semi-Tech, Inc.