Electroformed Copper

Ultra High Purity Copper is needed for a wide variety of experiments including those for the next generation of neutrino physics, dark matter, and material sciences

Must be electroformed underground to minimize cosmogenic ingrowth of impurities

Other materials may also require electroforming.

Existing Facilities

We can learn from:

- SUL
- LSC
- SURF

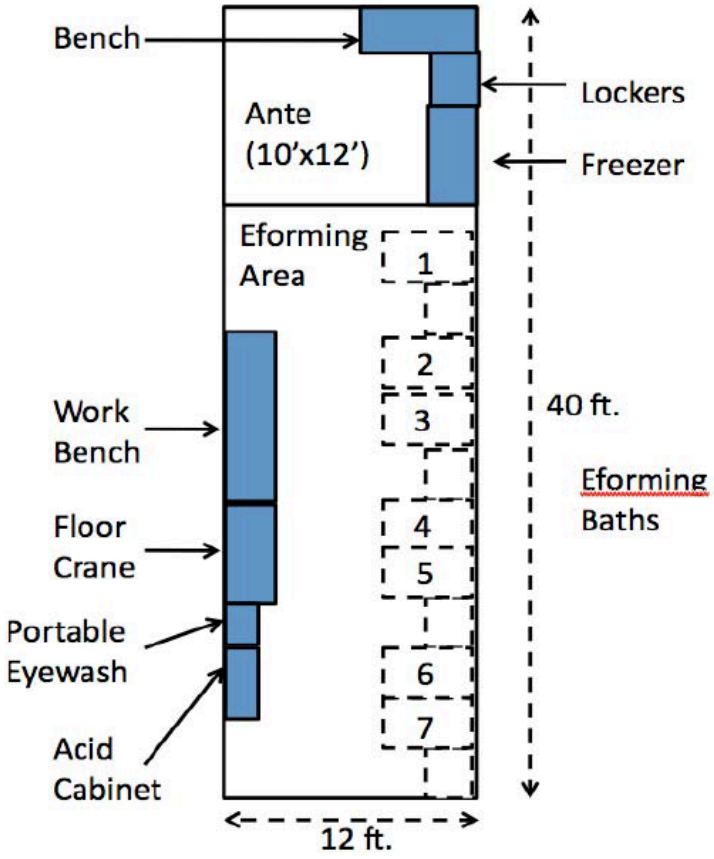
Cu	U [ppt]	Th [ppt]
OFHC*	0.2±0.01	1±0.06
E-formed	< 0.05	0.040±0.002

Layout

Cleanroom class 1000 for electroforming, class 100 for cleaning area

Large quantities of acid sulfate electrolyte anticipated

Extensively instrumented for process monitoring



Feasibility

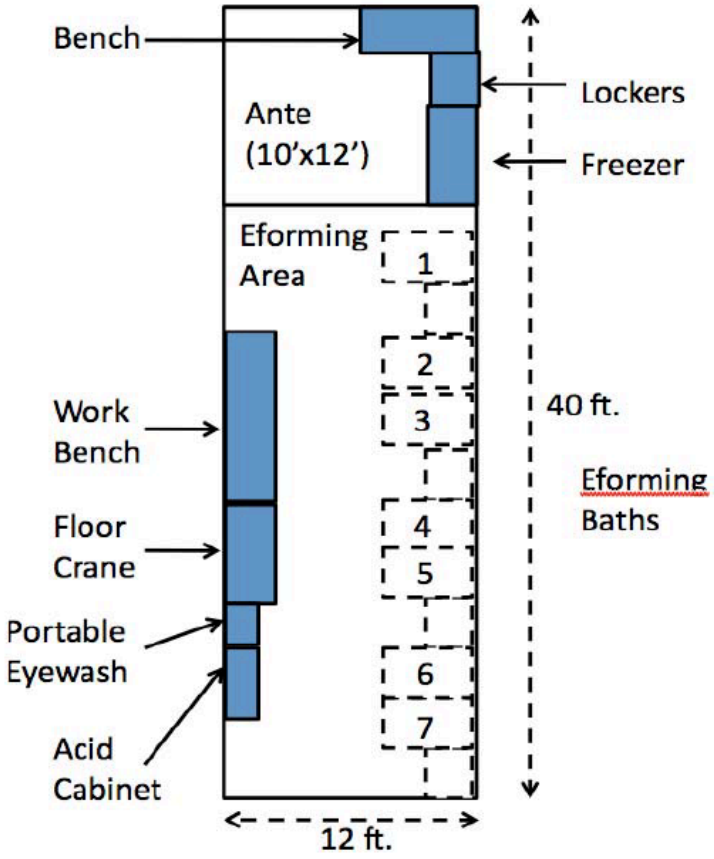
Bath cost ~$50k each

Capacity ~100 kg/bath/year

Easy and quick installation (a couple of months)

Pretty empirical

training is needed



Additional Requirements

Radioassay: more sensitive assays are certainly necessary to meet experiment goals

from LRT 2015: PNNL is able to screen Cu at sensitivities of

0.034 mBq ^{232}Th/kg

0.131 mBq ^{238}U/kg NIM A 775 (2015) 93-98

Clean Machine Shop

Storage area
(preferable low-radon environment. would the radon level U/G be a limiting factor?)

Crystal Growing

Crucible methods

– Stationary crucible methods

– Czochralski method

– Bridgman-Stockbarger method

– Stěpanov method (EFG)

– Zonal melting

Methods without crucible

– Verneuil method

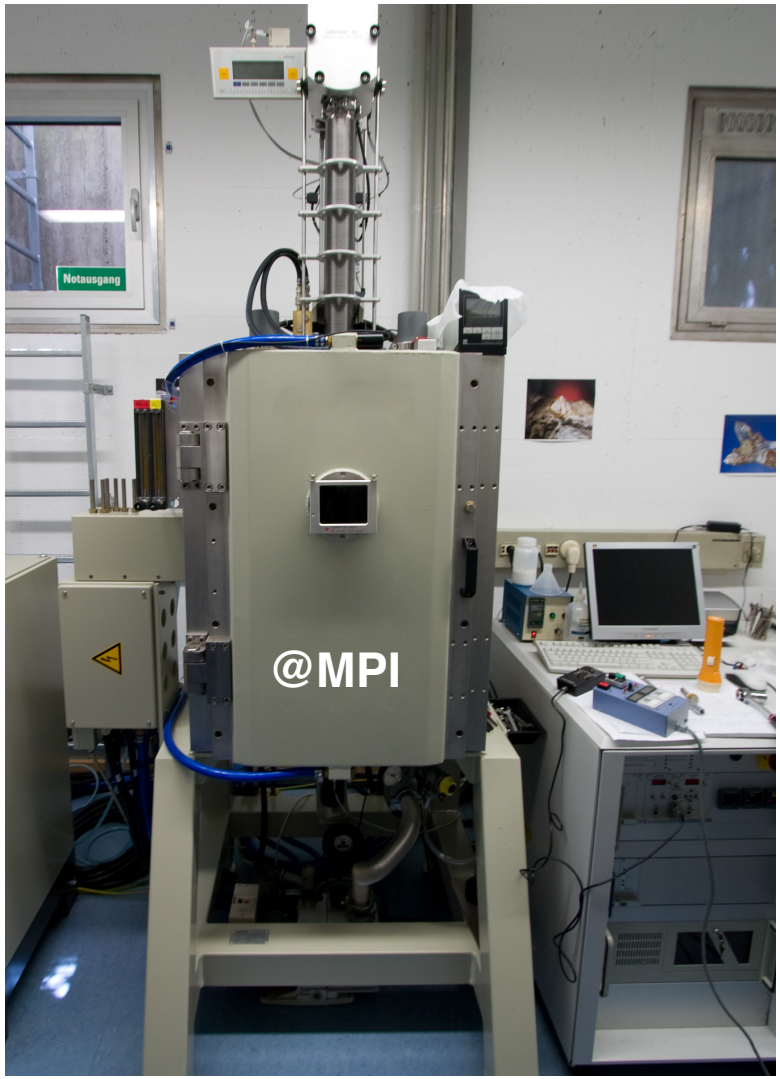
– `Cool crucible` method

Czochralski method

- growth of the best quality crystals from the own melt
- melt may not be volatile
- atmosphere problems

Si, Ge, Sn, Bi, Au, AlSb, InSGaSb, CsJ, KBr, CaF_2, BaF_2, NaCl, Li N, Al-Pd-Mn

Furnace example



Courtesy of CRESST

Furnace example

Courtesy of CRESST

Requirements

Create the seed with the right crystal orientation

Shape the crystal →diamond wire saw?

Storage area

Concerns

Pressure UG can enhance possibility of crystal cracks?

Radon level UG?