Procedure Outline for Making Metal Powder Filters

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The following pages outline a method for the creation of RF filters based on the very reliable "long insulated wire surrounded by conductive epoxy" design. Using a two-chamber filter design, with 1 m of wire in a Cu-epoxy and 1 m of wire in a stainless epoxy, attenuation levels in excess of 80 dB have been obtained.

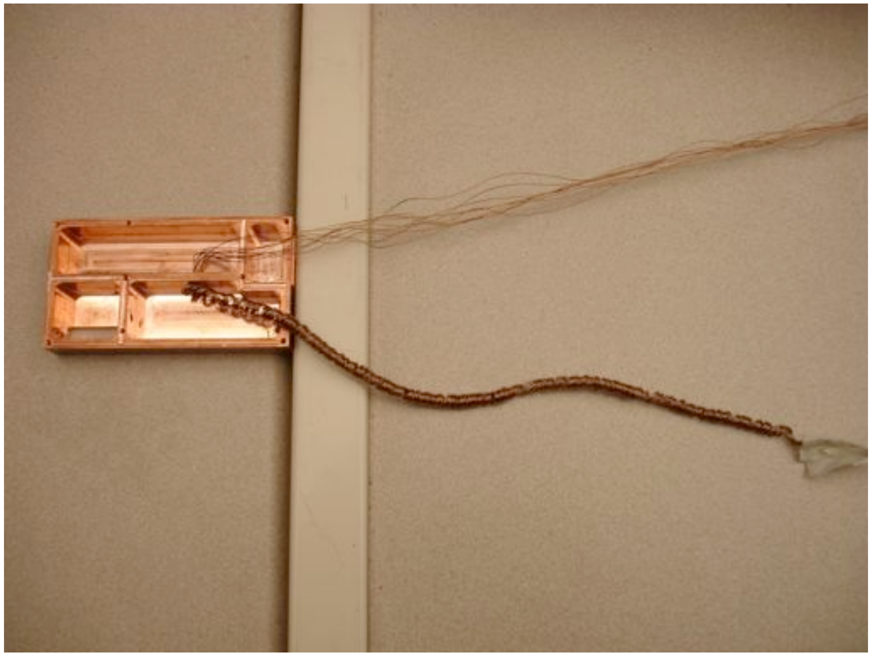
The filter enclosure should be prefabricated to meet your specific needs. For cryogenic applications, oxygen-free copper is preferred. Make sure to design your enclosure so that wire terminations at each end of the filter will be well-isolated from the other end.

Step 1: Twist wires

Use manganin fine wire (coated in hard formvar insulation).
Twist wires into quads, using power drill.
Prepare at least one (I prefer two) extra quads.

Step 2: Coil wires and insert into enclosure

Gather all quads together and wrap bundle around small rod repeatedly to form tight coils – threaded rods work best! Tight coils aid in stuffing lots of wire into small enclosures.



Step 3: Stuff wire coils into enclosure

If wire coils won't stay in place, use some 5-minute epoxy, mixed in equal parts with the appropriate metal powder, to "tack-weld" coils in place.
Use heat-shrink tubing to protect wire bundles from abrasion against enclosure

Step 4: Cover enclosure

Use tape (or something easy to remove later) to cover any open cavities of your enclosure.
Be sure to make at least two holes (or one large one, depending on design) to fill cavities with epoxy and simultaneously vent the displaced air.

Step 5: Prepare work surface for epoxy mess

Use aluminum foil, paper, etc. to prevent too much epoxy slop from ruining your workbench.
The epoxy is very runny when properly mixed; some care in handling is recommended, as are old clothes and/or a lab coat.

Step 6: Mix epoxy and add metal powder

Mix Stycast 1266 epoxy (mass ratio of parts A:B = 100:28).
Well-mixed epoxy will have translucent, runny, even consistency.
Add metal powder to well-mixed epoxy (mass ratio = 50:50).

Step 7: Pump air out of epoxy

Use vacuum jar (foil-lined for the mess) to extract air from epoxy.
Multiple pump-down cycles required (15+, about 45 min. total).
As foam reaches critical density, it will catastrophically collapse.

Step 8: Prepare syringe

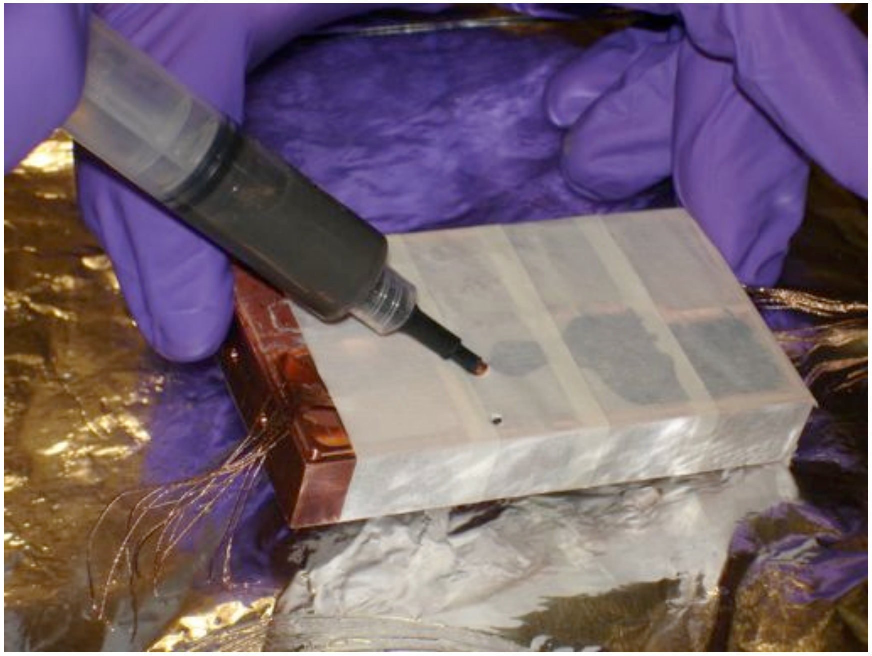
Use a disposable plastic syringe; no needle tip required.
I like to use a thin metal tube (secured with heatshrink) to make a rigid nozzle, but the blunt plastic syringe end also works well.

Step 9: Fill syringe

Carefully pour epoxy into syringe.
Some may leak out of tip – use gloved finger to block or place tip in cavity to be filled.

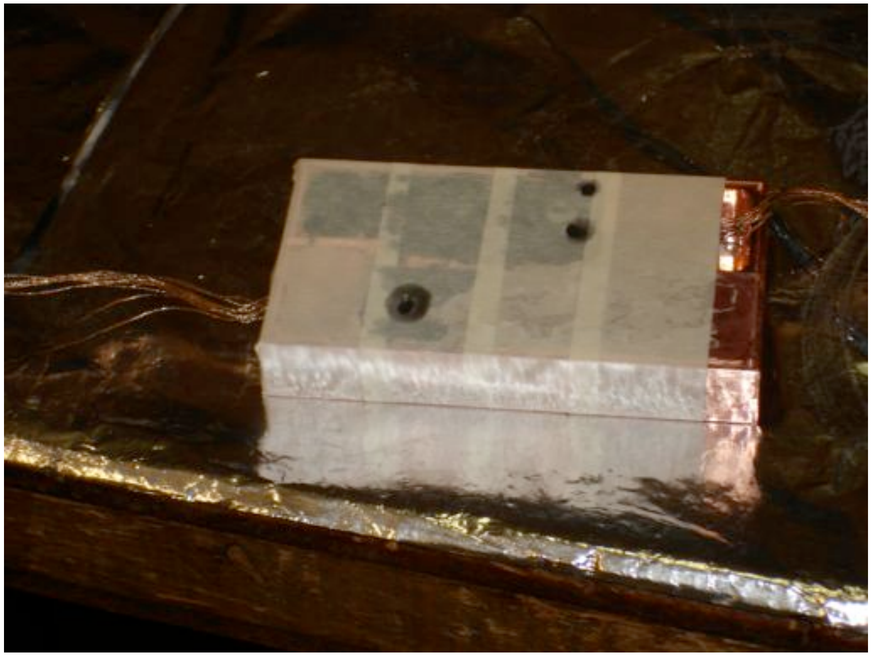
Step 10: Inject epoxy

Slowly inject epoxy into cavity.
Tapping, vibrating, shaking, etc. will help settle and distribute epoxy around all the wire surfaces and completely fill the cavity.



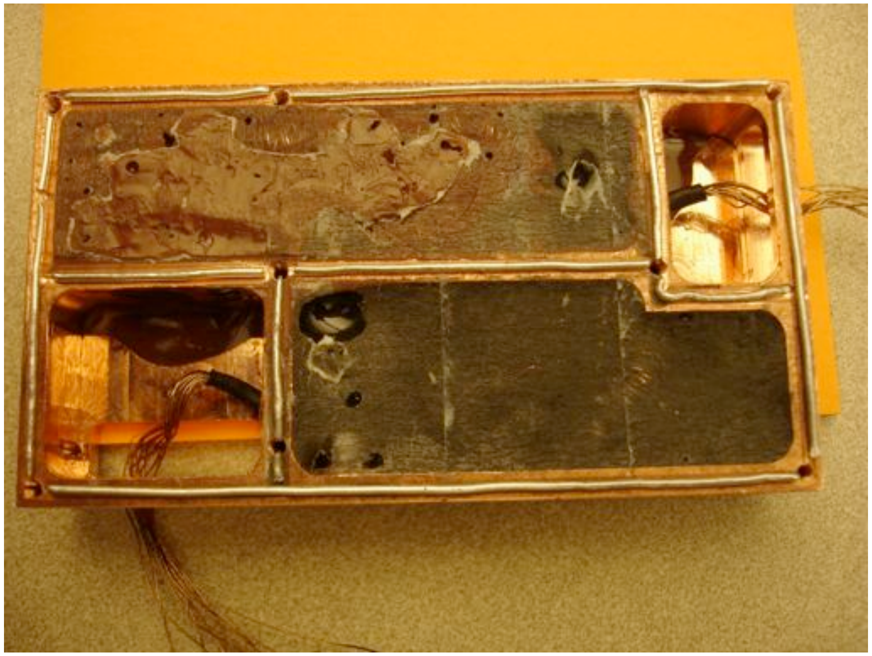
Step 11: Cure epoxy overnight

Stycast will cure overnight by itself.
Curing can be accelerated using low heat (< 65°C)
The heat from an incandescent desk lamp works well for this.



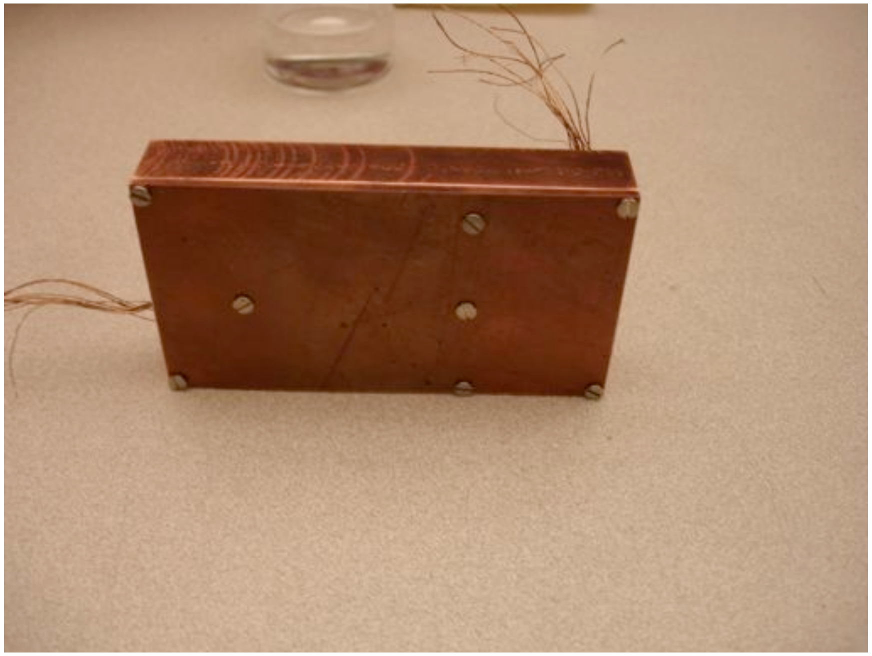
Step 12: Prepare enclosure for sealing

Using indium wire, metal tape, pre-fabricated cover pieces, etc., ready the enclosure for wire sealing and wire termination.



Step 13: Seal up enclosure

Button up the enclosure, taking care to ensure that the wire terminations at each end will be well-isolated from one another.



Step 14: Terminate wiring

Connect wires to D-connectors, etc., according to your design. Tracing out the corresponding wires on each end can be tedious. I like to note who fabricated the filter and when by scratching my initials and the month/year onto the copper exterior.

Step 15:

Install filter, making sure to heatsink properly if necessary. Testing the performance of the filter can be tricky – custom-built cabling and a network analyzer are best – one must take great care to isolated the connectors at each end.