



# Q u a n t u m D e s i g n

---

## A p p l i c a t i o n s

### Recommended Materials for Electrical Transport Sample Mounting

Making good ohmic contact to a research sample for measuring electrical transport properties (longitudinal resistance, Hall measurements, van der Pauw, etc.) is non-trivial. In the most ideal case, a wire-bonder is used to make contact with both the sample and the contact pad on the puck using gold wire, but this is not always an option for any number of reasons (sample composition, shape, mechanical integrity, lack of wire-bonding equipment, and so on).

A common alternative is to instead affix the lead to the sample using some type of conducting adhesive, and, when dry, soldering the other end to the appropriate pad on the puck. The details of the technique will vary somewhat depending on the sample geometry, but below is a list of items which can be of use in many common cases.

## Puck Connections

**Solder** – Many, many options. More likely than not, whatever is lying around the lab will suffice. If new solder will be purchased, something with a lower melting point is recommended (if the iron/liquid solder is very hot, the gold wire will dissolve directly into the melt before the iron tip can be removed).

**Wire** – Many choices exist, and the particular needs of the sample/measurement should be considered. Particularly for larger samples, any reasonably electrically conductive wire (copper, manganin, phosphor bronze, silver, gold, associated alloys) will work. Limitations on gauge arise for custom experiments employing high current.

For the smallest, most challenging samples though, very thin (ie: 1 mil [0.001 inch] diameter) gold-wire is recommended. This is the type of wire commonly used in wire-bonding. Coupled with the silver paint, the small diameter allows two/four probe contact arrangements to be made on extremely small bulk samples (ie: single crystals) where there is limited surface area.

USA Distributor:

Ametek/Coining <http://www.ametek-ecp.com/products/componentswire/wireandribbon/goldwireandribbon>

TopLine/Tanaka [http://www.topline.tv/tanaka.html#Au\\_Wire](http://www.topline.tv/tanaka.html#Au_Wire)

Datasheet:

[http://www.ametek-ecp.com/-/media/ametek-ecp/files/productdownloadabledocuments/componentswire/au\\_wire\\_ribbon\\_product\\_data\\_sheet.pdf?la=en](http://www.ametek-ecp.com/-/media/ametek-ecp/files/productdownloadabledocuments/componentswire/au_wire_ribbon_product_data_sheet.pdf?la=en)

## Conducting Adhesives

**DuPont 4929N** – Commonly referred to as ‘silver paint’, this material is easy to control if properly thinned, and has a fairly forgiving working time. The one drawback being that mechanically it’s not especially strong (compared to the epoxy below).

USA Distributor: W. K. Robson

<http://www.dupont.com/products-and-services/electronic-electrical-materials/articles/distributor-robson.html>

Datasheet:

<http://www.dupont.com/content/dam/dupont/products-and-services/electronic-and-electrical-materials/documents/prodlib/AirDryAgSelectorGuide.pdf>

Solvent: 2-butoxyethyl acetate

<http://www.sigmaaldrich.com/catalog/product/aldrich/307289?lang=en&region=US>

Note: this specific solvent is very important; ethanol, acetone, toluene- none of them will work half as well as the 2-butoxyethyl acetate compound (those other solvents actually work quite poorly, and will not allow for quality contacts). Also: not much is needed so it’s recommended to order the smallest volume available.

**EpoTek H20E** – Commonly referred to as ‘silver epoxy’, this material is mixed from two parts and must be cured above 80°C. It is more viscous than the thinned paint, and thus somewhat more difficult to work with for small samples. The advantage it offers is a permanent bond with good mechanical strength.

USA Distributor: Various Reps

<http://www.epotek.com/site/rebs.html>

Datasheet:

<http://www.epotek.com/site/component/products/productdetail.html?cid=84&Itemid=435>

[http://www.epotek.com/site/administrator/components/com\\_products/assets/files/Style\\_Uploads/H20E.pdf](http://www.epotek.com/site/administrator/components/com_products/assets/files/Style_Uploads/H20E.pdf)

## Mechanical/Thermal Anchoring

**GE Varnish** – Also called GE 7031 or VGE 7031. This varnish is a general-purpose adhesive which maintains its properties down to cryogenic temperatures. It is a reasonably good thermal conductor and an electrical insulator, ideal for mechanically anchoring samples to a puck before attempting to attach electrical leads. Can be thinned to desired consistency and dries in air. Solvent will loosen and eventually dissolve the varnish if removal is later desired.

USA Distributors:

Lakeshore: <http://www.lakeshore.com/products/cryogenic-accessories/varnish/Pages/Overview.aspx>

CMR-Direct: <http://www.cmr-direct.com/en/cmr-gevar-25ml>

Solvent – 50:50 (by volume) mix of ethanol and toluene.

**Stycast 2850-FT** – This two-component epoxy provides superior thermal and mechanical performance down to cryogenic temperatures. It is thermally conductive and electrically insulating, making it ideal for mounting sensors (temperature, Hall) or chip carrier sockets in customized transport setups. Permanently cures in air in roughly 24 hours, or just a few hours at sufficiently higher temperatures.

USA Distributors:

Lakeshore: <http://www.lakeshore.com/products/cryogenic-accessories/epoxy/pages/Overview.aspx>

CMR-Direct: <http://www.cmr-direct.com/en/stycast-2850FT-2>