

Building Soft Computers: Materials, Techniques and Tools

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Overview

- Materials
 - Conductive threads or “yarns”
 - Conductive fabrics
 - Connectors
 - Insulators
 - Other materials
- Techniques
 - Finding sewable components
 - Making components sewable
 - Building fabric PCBs
- Tools

Materials: Conductive Yarns



Conductive Yarns: Metal Wrapped

- Fabric core wrapped with metal
- Highly conductive
- Beautiful
- Fragile
- Sewability: not machine sewable
- Where to get:
 - <http://www.tinseltrading.com/>:
gorgeous antique metal threads
 - <http://www.tlbarnes.com>
 - <http://www.jdr-be.com>



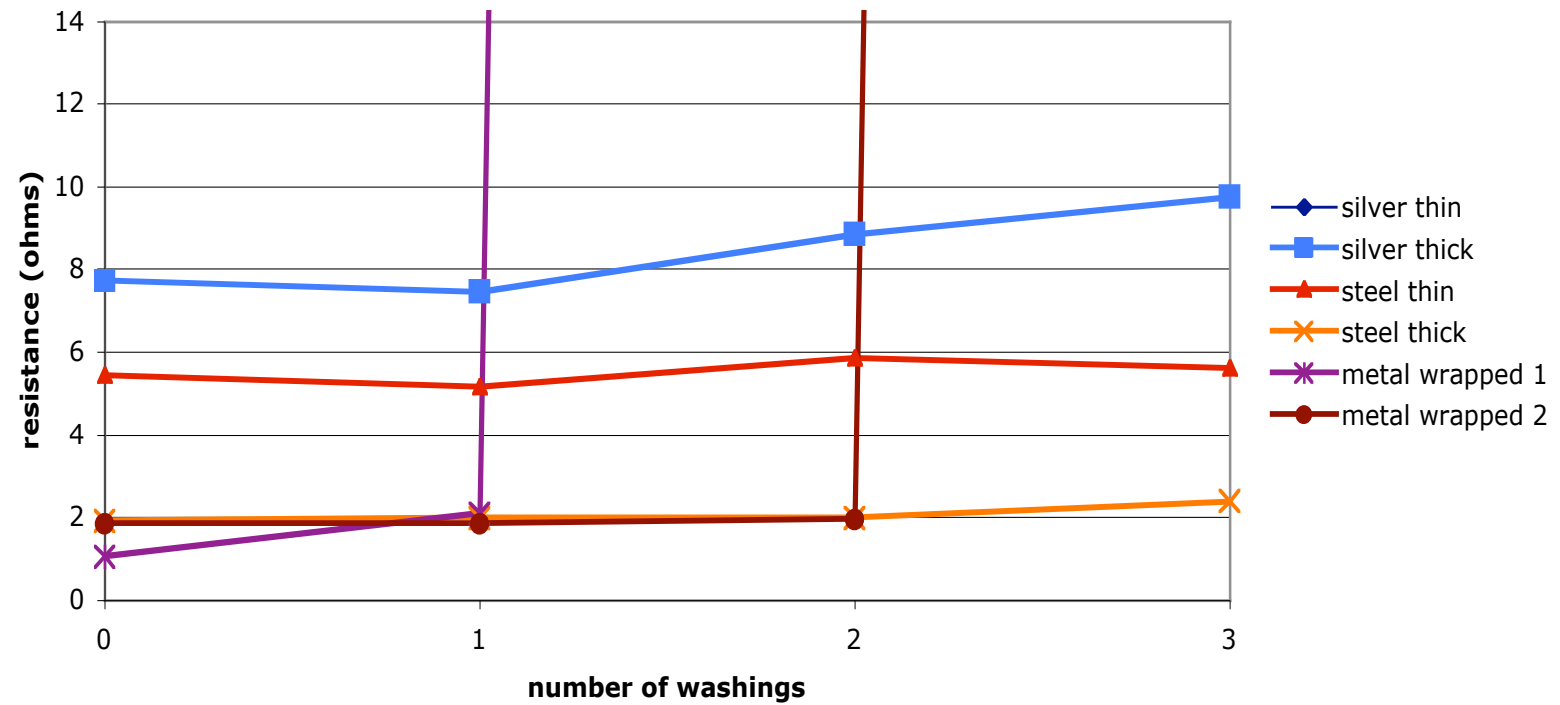
Conductive Yarns: Metal Plated

- Fabric core plated with metal (usually silver)
- Reasonably conductive
- Plating tarnishes and cracks with washing and wear
- Can be polished
- Sewability: some varieties machine sewable
- Where to get:
 - <http://www.fine-silver-productsnet.com/>
 - 234/34x4: approx. 14 Ω s/foot (bobbin sewable)
 - 117/17x2: approx. 85 Ω s/foot (machine sewable)
 - <http://www.lessemf.com>
 - <http://members.shaw.ca/ubik/thread/index.html>

Conductive Yarns: Spun Stainless Steel

- 100% stainless steel
- Highly conductive
- Corrosion resistant
- Difficult to work with
- Sewability: some varieties machine sewable as bobbin thread
- Where to get:
 - <http://www.texturatrading.com>

Conductive Yarns: Washability



Materials: Conductive Fabrics



Conductive Fabrics: Constructed with Conductive Yarns

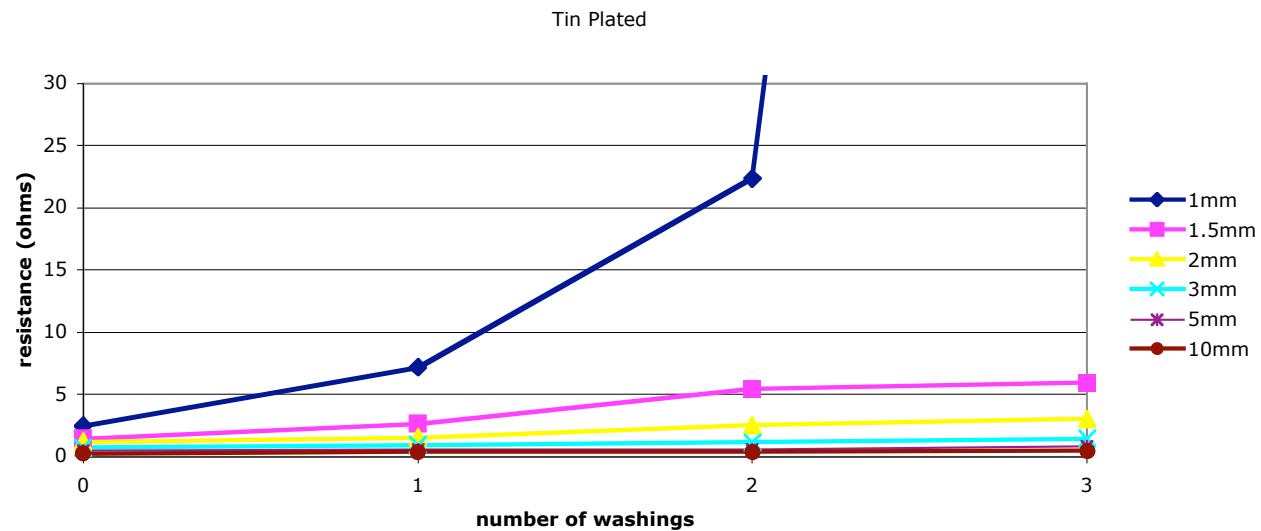
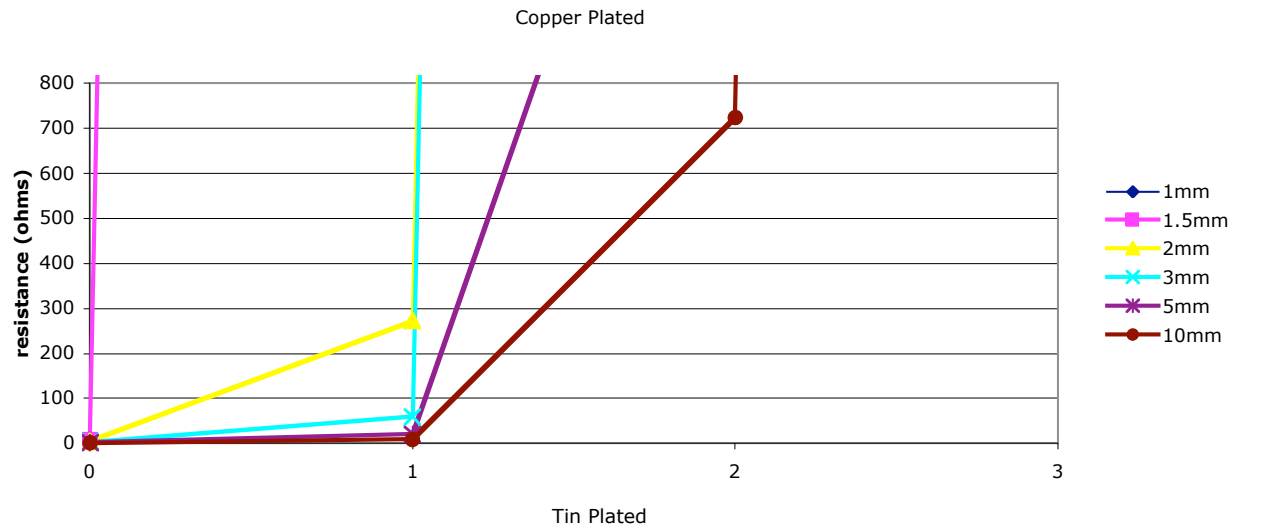
- Most highly conductive
- Often beautiful
- Sometimes useful weaves (ie: lines)
- Often very expensive
- Where to get
 - <http://www.tinseltrading.com/>:
gorgeous antique metal fabrics and trimmings
 - <http://www.lessemf.com/>:
knit stainless steel mesh
 - “upscale” fabric shops:
metal fabrics



Conductive Fabrics: Metal Plated

- Traditional cloth plated with metal
- Common platings
 - Copper
 - Tin
 - Silver
- Most highly conductive
- Where to get
 - <http://www.lessemf.com/>
 - Zelt: Tin/Copper plated fabric, highly conductive and corrosion resistant
 - Stretch silver plated fabric
 - Silver plated velcro (“hook and loop”)
 - Translucent conductive mesh fabrics
 - <http://www.fine-silver-productsnet.com/>

Conductive Fabrics: Washability

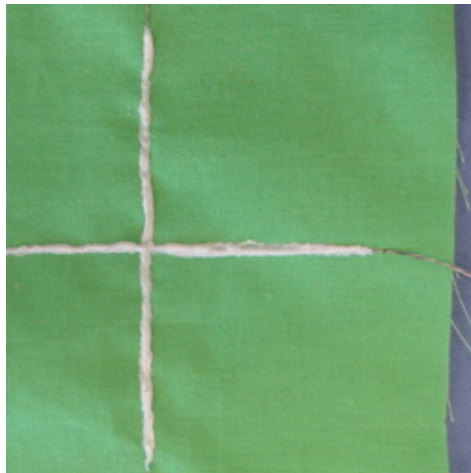


Materials: Connectors

- Snaps
 - Excellent mechanical connection
 - Noisy/unreliable electrical connection
 - Electrical connection best with spring/”anorak” snaps
 - Easy attachment
- Sewable ring magnets
 - Good mechanical connection
 - Good electrical connection
 - Labor intensive attachment
- Jewelry Connectors
 - Range of mechanical and electrical connections
 - Labor intensive attachment
- Electronic Connectors
 - Range of mechanical connections
 - Good electrical connections
 - Labor intensive attachment

Materials: Insulators and Protectors

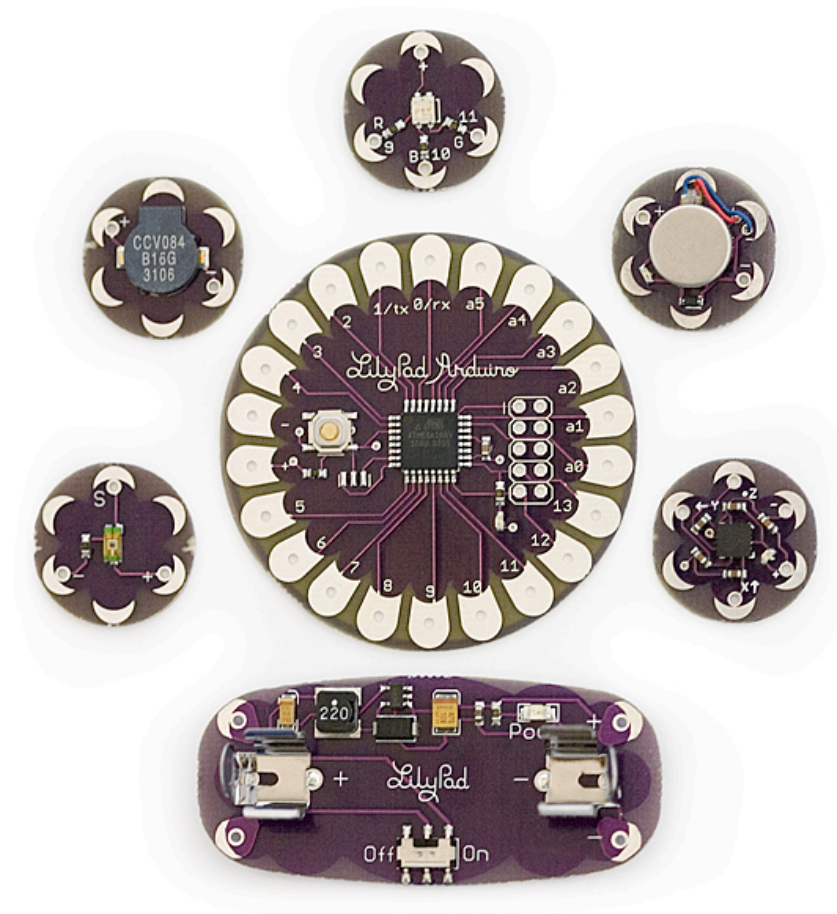
- Embroidery
- Fabric paint
- Silicone, latex, etc.
- Iron-on patches
- Waterproofing sprays



Other Useful Materials: Sensors

- Force sensitive resistors (FSRs) (get the tape - FSR408)
 - <http://www.imagesco.com>
- Stretch sensors
 - <http://www.imagesco.com>
- Force sensitive rubber (Zoflex); stretch sensor
 - <http://www.rfmicrolink.com/zoflex.html>
- Vibration/bend/sound/pressure sensors (piezoelectric films) (can also be used to generate small amounts of power)
 - <http://www.imagesco.com>

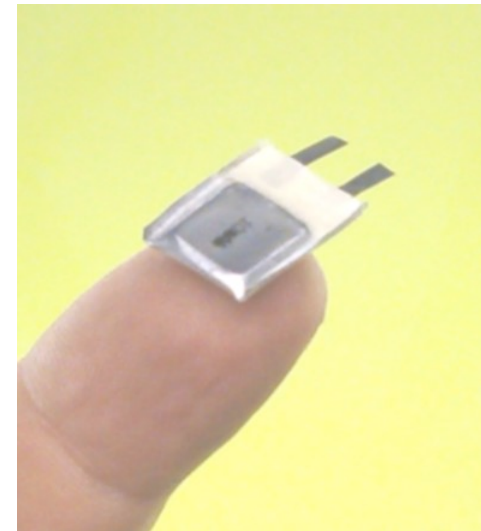
Other Useful Materials: LilyPad Arduino



<http://www.sparkfun.com>

Other Useful Materials

- Flexible and tiny rechargeable Lithium Ion batteries
 - <http://www.all-battery.com>
 - <http://www.powerstream.com>
- Flexible solar panels
 - <http://www.solar-world.com/>
- Conductive paint and ink
 - <http://www.lessemf.com>
- Thermochromic (temperature sensitive) ink
 - <http://www.ctiinks.com>



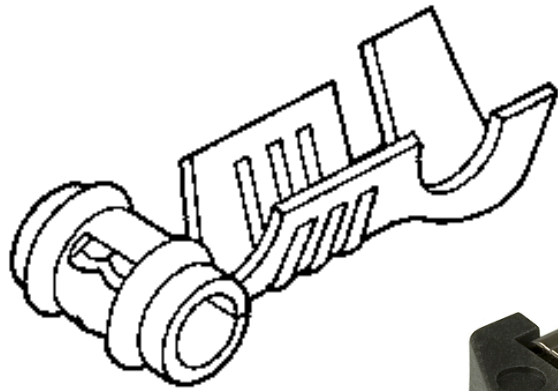
The Future for Soft Computing Materials Looks Even More Interesting...

- E-Ink
- Printable LEDs
- Printable batteries
- Printable...
- Fabric-based transistors

On to Techniques...

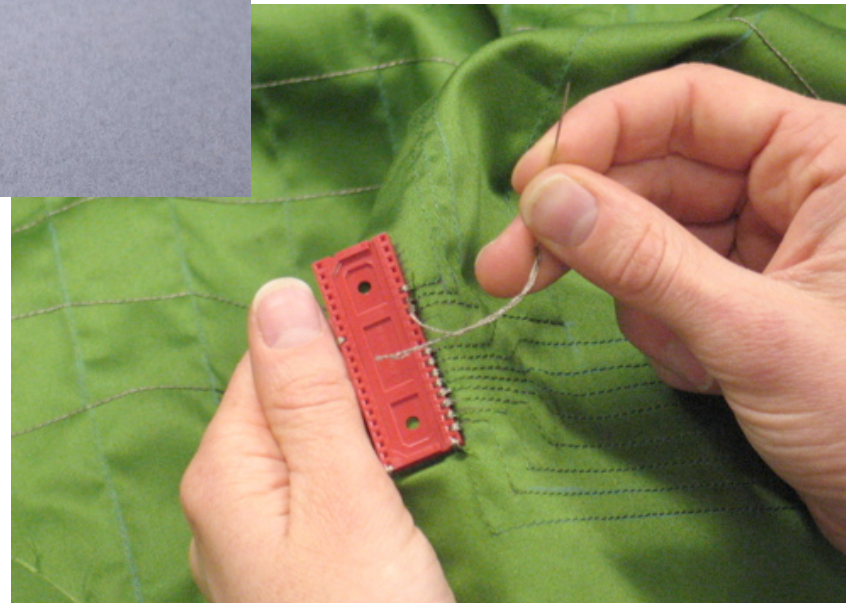
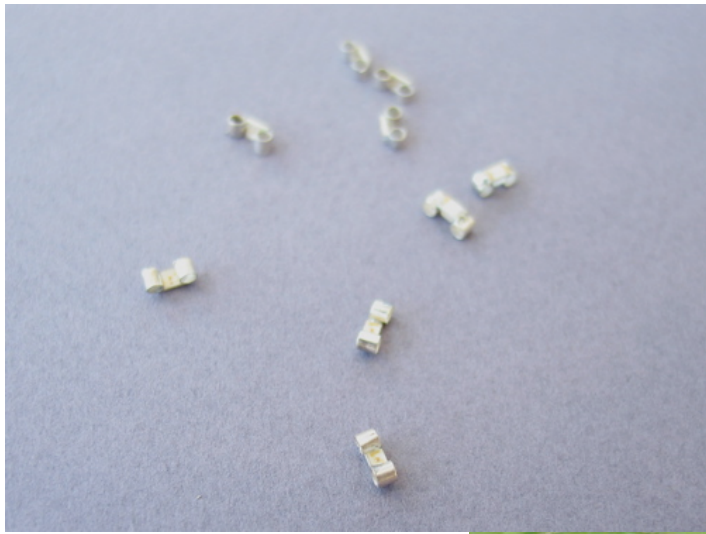
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Techniques: Finding Sewable Components



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Techniques: Making Components Sewable



Building Fabric PCBs: Materials

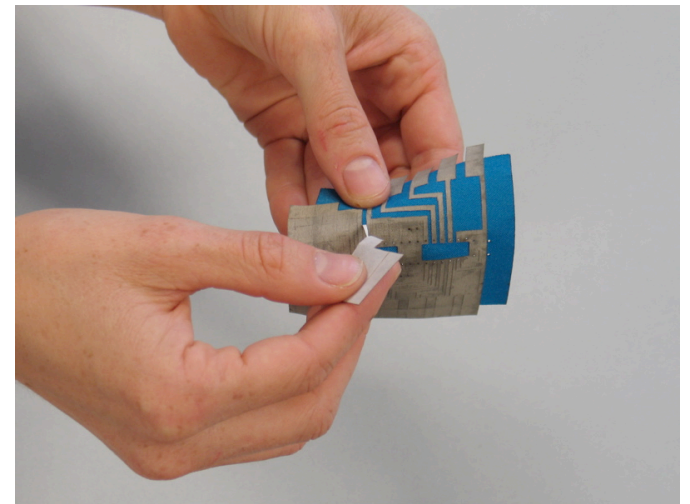
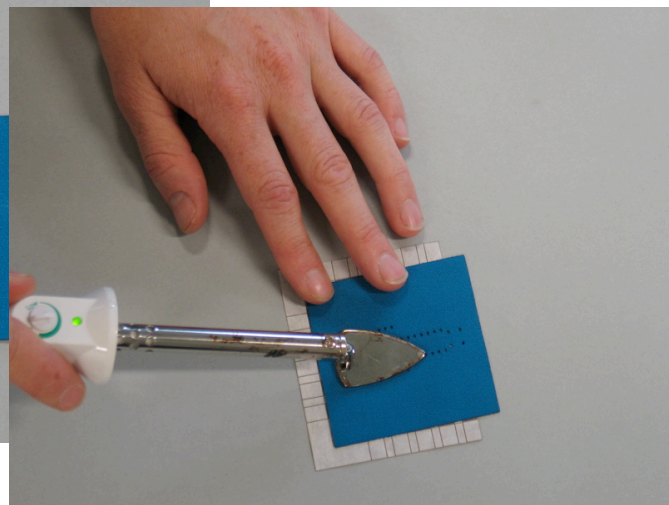
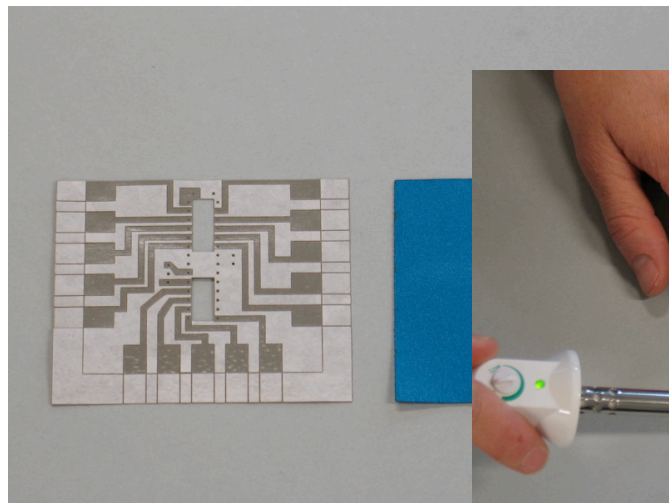
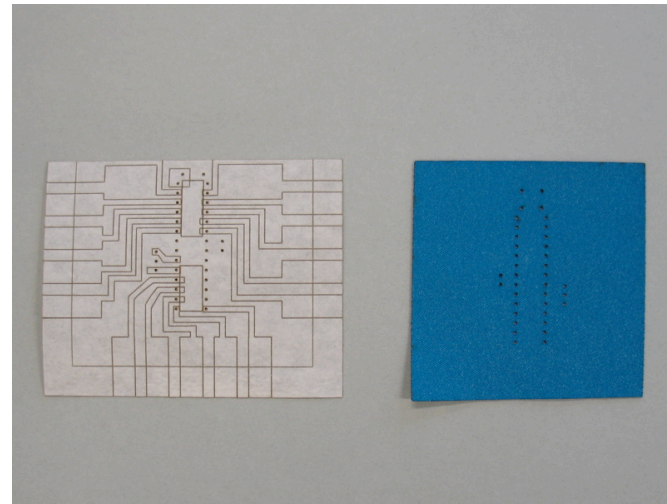
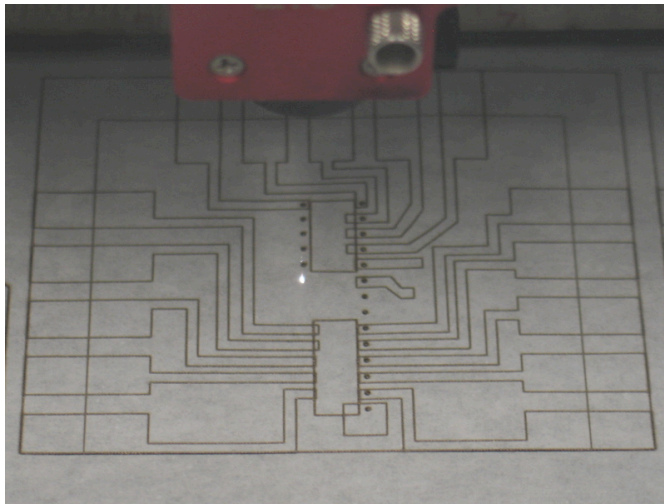
- Zelt, Cu/Sn plated conductive fabric
- Heat-n-Bond UltraBond Iron-on Adhesive
- Regular fabric (to attach circuit to)
- Small iron
- Laser cutter
- Flux
- Soldering iron
- Solder



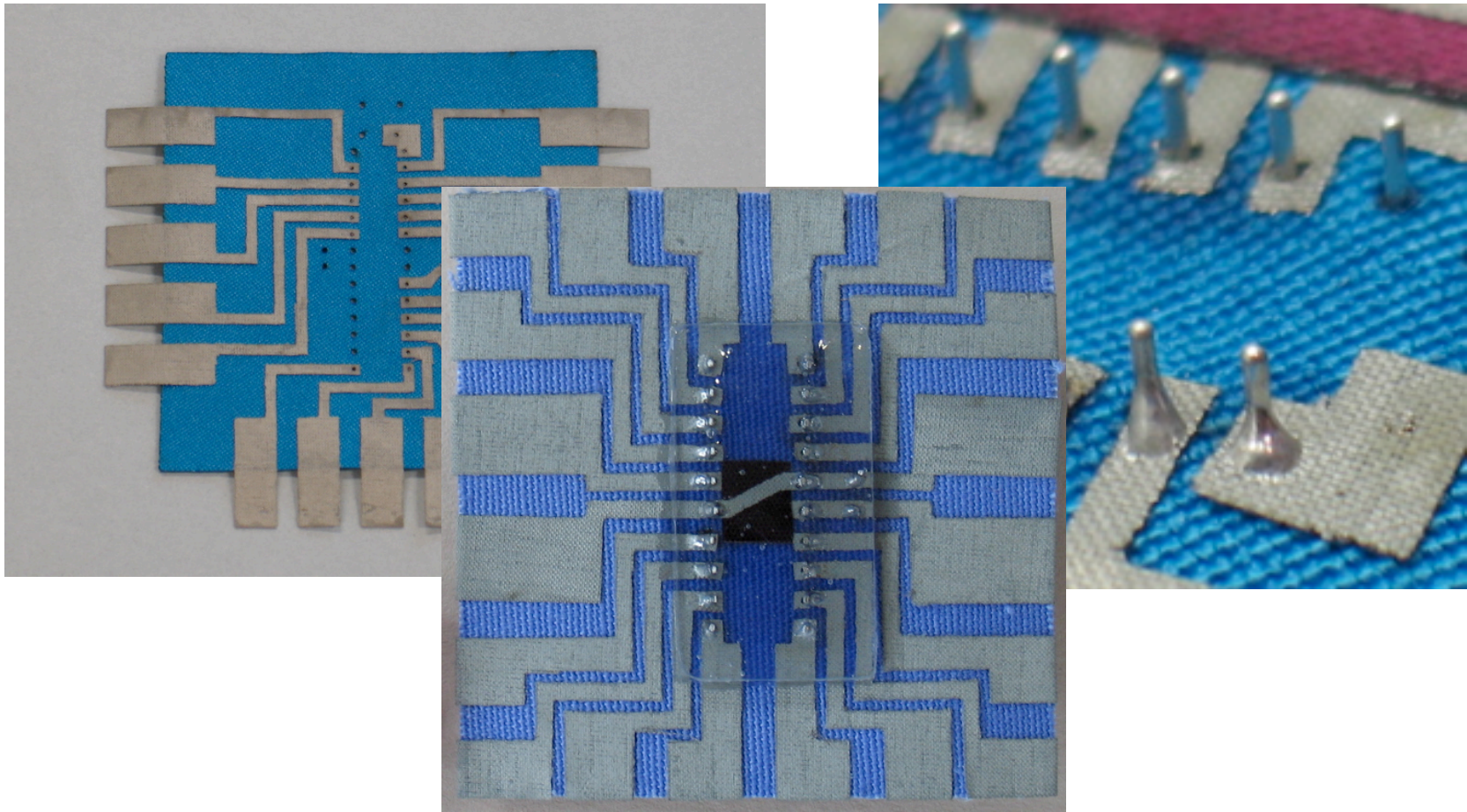
Building Fabric PCBs: Steps

- Iron Heat-n-Bond to conductive fabric
- Put fabric face down into laser cutter
- Etch circuit with laser cutter
- Remove paper backing from fabric only underneath circuit
- Iron circuit onto its backing cloth
- Remove extra pieces of conductive cloth
- *Apply liberal amounts of flux to fabric PCB and parts to be soldered*
- Solder the circuit
- Protect solder joints with hard resin coating

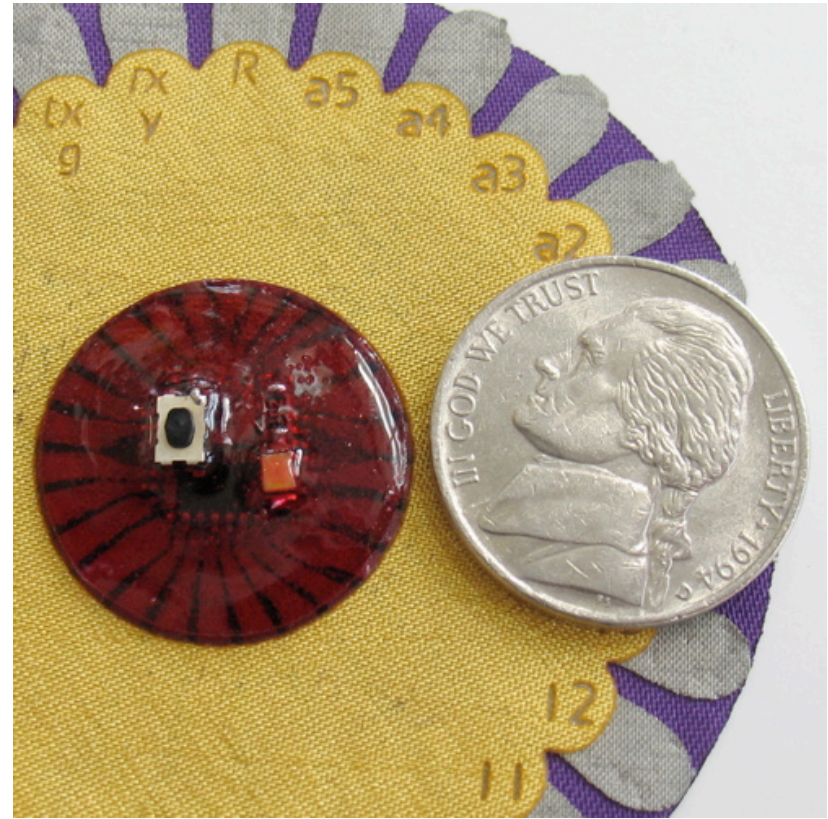
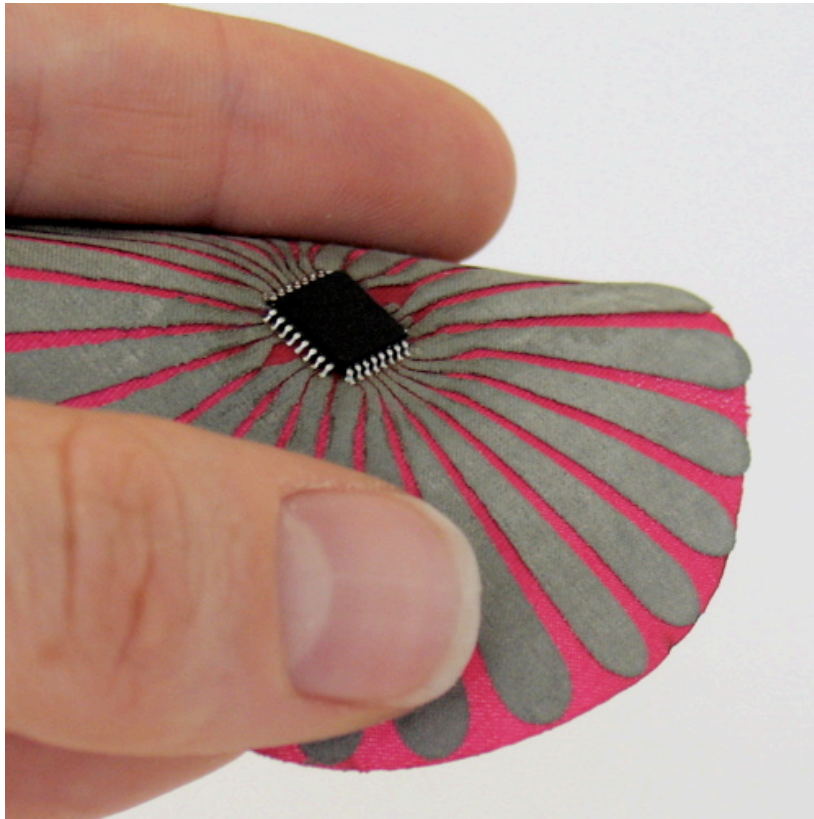
Building Fabric PCBs



Building Fabric PCBs cont.



Fabric PCBs for SMD components



See the excellent SMD soldering tutorials at [SparkFun](https://www.sparkfun.com) (just don't use a hot plate or heat gun with fabric circuits)

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Tools

- Laser Cutters
- Embroidery Machines
- Knitting Machines
- Looms
- Textile Printers
- 3D Printers

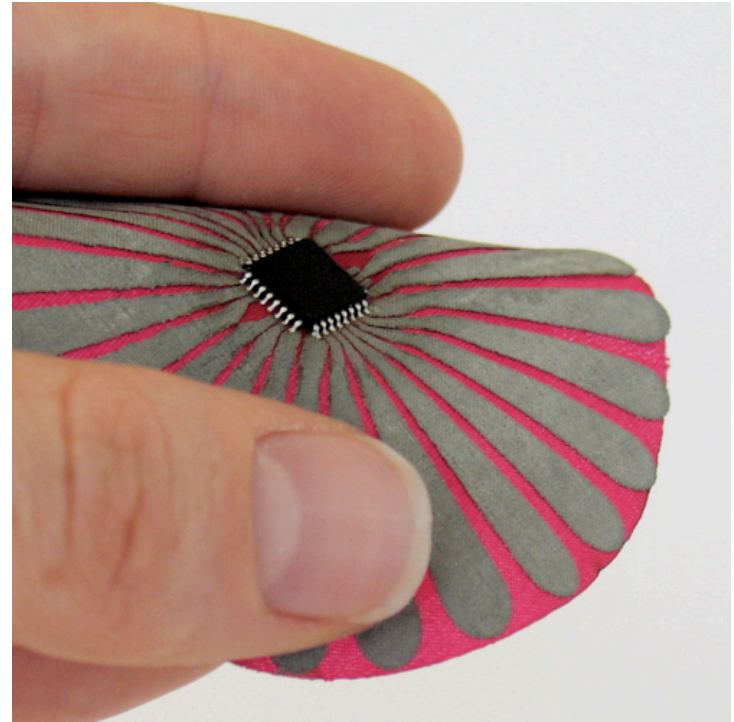


(see my website for tool links:
http://www.cs.colorado.edu/~buechley/links/machine_links.html)

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Thank you!



Questions?

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Links from our discussion

Thread

Bekaert USA:

Tom Lloyd

Tom.Lloyd@bekaert.com

T +1 770-514-2251

F +1 770-426-8107

amber strand (copper thread link from despina):

<http://www.amberstrand.com/>

Misc.

make your own conductive glue tutorial (could use to make your own pressure sensing rubber?):

<http://www.instructables.com/id/Make-Conductive-Glue-and-Glue-a-Circuit/>

some medical stuff (bio gel, electrodes, etc.):

<http://www.vitalityweb.com/backstore/electrode-gel.htm>

magnetic snaps that can be soldered (from despina):

http://www.rnllee.com/description/cigarbox_supplies.htm

http://www.bagfittings.com.hk/magnetic_snaps_03.htm

tiny IDC (insulation displacement connector) (from Tom) (# avx9175)

http://www.newark.com/jsp/Interconnect++Products,+Wire+&+Cable/Connectors/AVX/009175002001006/displayProduct.jsp?sku=40M7660&_requestid=199267

Wibree (next generation bluetooth, low power) (from Selene):

<http://en.wikipedia.org/wiki/Wibree>

tiny surface-mount USB connector:

http://www.sparkfun.com/commerce/product_info.php?products_id=587

Tools

avl jaquard loom ~\$50k (from Tom):

<http://www.avlusa.com/index/products/looms/jacquard/>

