

# NEW TEXTILES

MAS 681, E14-493

Professor: Leah Buechley

TA: Emily Lovell

Tuesdays 3-6pm

<http://newtextiles.media.mit.edu/2012>

# SOFT ELECTRONICS

# CONDUCTIVE TEXTILES



# UNITS & MEASUREMENT

## CONDUCTIVITY

## **Resistance ( $R$ )**

an empirical measurement, dependent on material  
and length, area, or volume  
measured in Ohms  $\Omega$

## **Resistivity ( $\rho$ )**

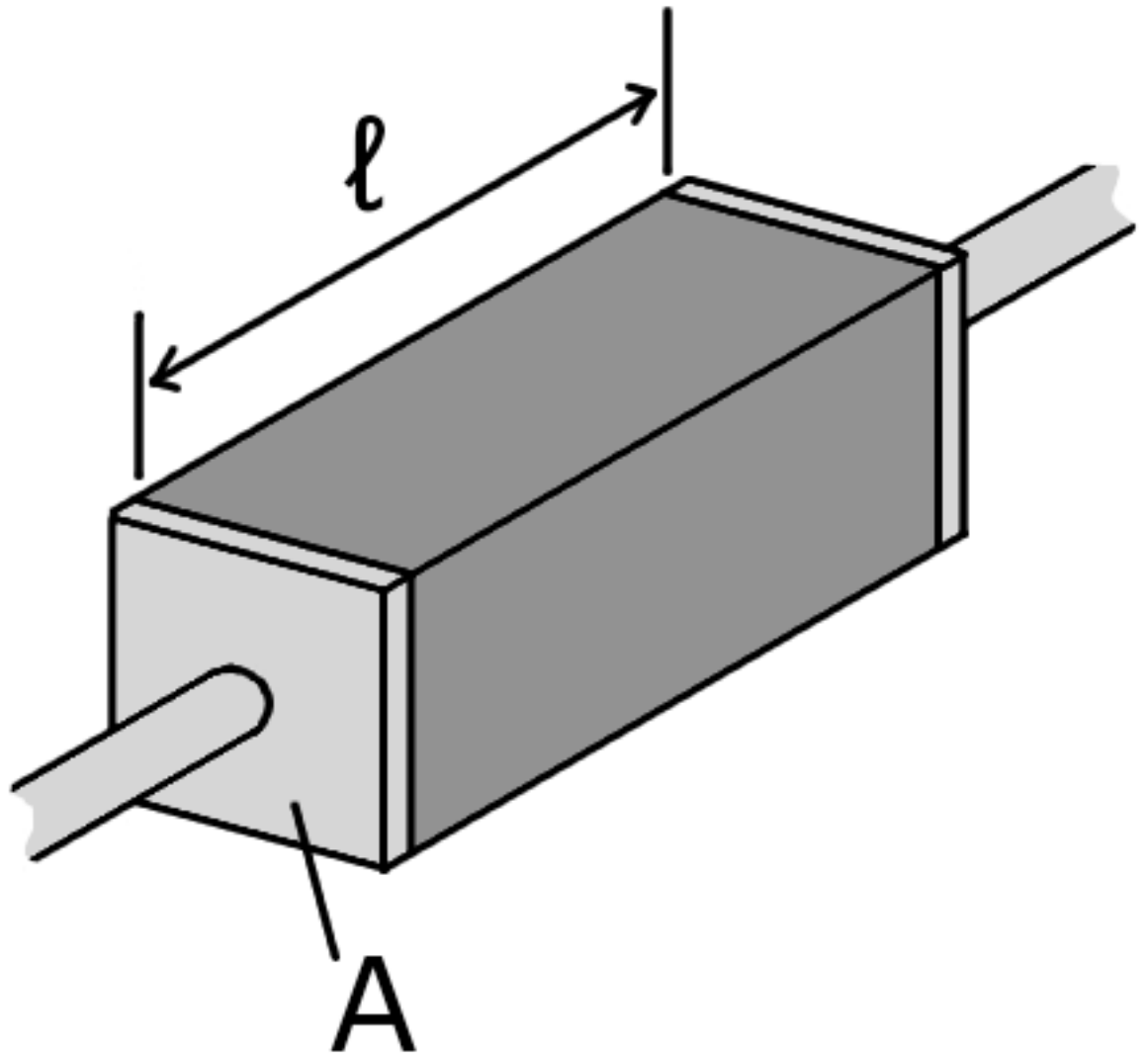
an intrinsic property of a material  
measured in Ohm meters  $\Omega m$

## **Conductivity ( $\sigma$ )**

an intrinsic property of a material  
the inverse of resistivity  
measured in siemens/meter  $S / m$

$$\rho = R \frac{A}{\ell}$$

$$\sigma = \frac{1}{\rho}$$



Material	$\rho$ ( $\Omega m$ )	$\sigma$ (S/m)
Silver	0.0000000159	63,000,000
Copper	0.0000000168	59,600,000
Gold	0.0000000244	58,000,000
Aluminum	0.0000000282	35,000,000
Nickel	0.0000000699	14,300,000
Tin	0.0000000109	9,170,000
Carbon (graphite)	0.0000078	128,200
Sea water	0.2	4.8
Distilled fresh water	180,000	0.0000055
Glass	$1.0 \times 10^{10}$	$1.0 \times 10^{-10}$
Air	$1.3 \times 10^{16}$	$8.0 \times 10^{-15}$

All measurements at 20°C

The Physics Factbook: <http://hypertextbook.com/facts/index-topics.shtml>

[http://en.wikipedia.org/wiki/Electrical\\_resistivity\\_and\\_conductivity](http://en.wikipedia.org/wiki/Electrical_resistivity_and_conductivity)

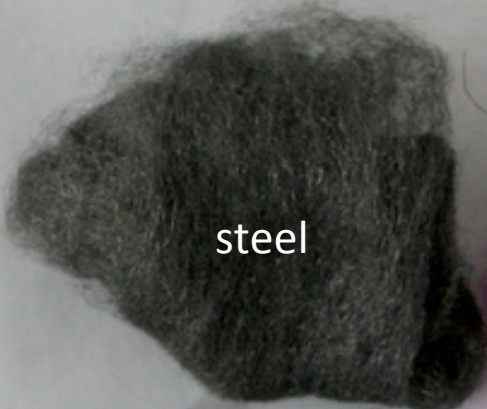


**FIBERS**

# FIBER

“Any substance, natural or manufactured, with a high length to width ration and with suitable characteristics for being processed into a fabric.”

- Kadolph, S. (2007), *Textiles*, Prentice Hall, Upper Saddle River, NJ



steel



wool



sisal



carbon



cotton



aluminum



copper



hemp



polyester-  
acrylic

# Conductive fibers

- Metal: copper, steel, tin, aluminum
- Carbon
- Carbon nanotube

**YARNS**

# YARN

“A continuous strand of textile fibers, filaments, or materials in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric”

- American Society for Testing and Materials (ASTM)



# Conductive yarns: metal wrapped

- Fabric core wrapped with metal
- Highly conductive
- Beautiful
- Fragile
- Sewability: not machine sewable





# Conductive yarns: metal plated

- Fabric core plated with metal (most commonly silver)
- Reasonably conductive
- Plating tarnishes and cracks with washing and wear
- Silver can be polished
- Sewability: some varieties machine sewable

# Conductive yarns: spun metal fibers or filaments

- Different metal/fabric blends
- 100% stainless steel
  - Highly conductive
  - Corrosion resistant
  - Difficult to work with
- Stainless/wool and stainless/polyester blends
  - Resistive
- Sewability: some varieties machine sewable as bobbin thread

# Conductive yarns: stranded wire

- 100% metal core
- Highly conductive
- Insulated
- Contact points need to be stripped and soldered
- Stripped wire vulnerable to breakage
- Sewability: some varieties machine sewable as bobbin thread

# FABRICS

# FABRIC

“A planar substance constructed from solutions, fibers, yarns, fabrics, or any combination of these.”

- Kadolph, S. (2007), *Textiles*, Prentice Hall, Upper Saddle River, NJ



# Fabrics constructed with conductive yarns

- Most are highly conductive
- Beautiful
- Sometimes useful weaves (ie: lines)
- Often very expensive



# Conductive fabrics: metal plated

- Traditional cloth plated with metal
- Common platings
  - Copper
  - Tin
  - Nickel
  - Silver
- Most are highly conductive



# 1ST HANDS-ON ASSIGNMENT

conductive yarns + conductivity

<http://newtextiles.media.mit.edu/2012>

# LAB SESSION

this week: 3-6pm on Thursday February 9

# 1ST ASSIGNMENT

registration survey  
due Wednesday, February 8