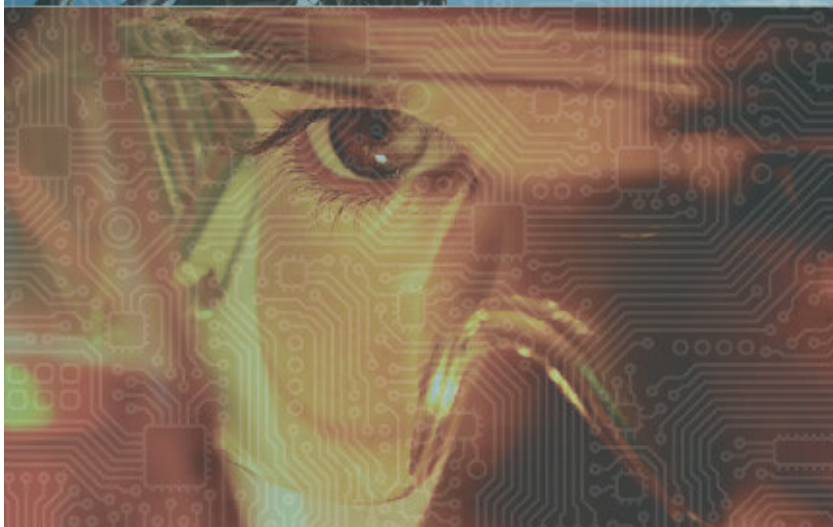


# YOU IMAGINE. WE ENABLE.



**Endicott Interconnect**  
Technologies, Inc.

**Development of Electronic Substrates for Medical Device Applications**

**2012 IMAPS Device Packaging**

# Development of Electronic Substrates for Medical Device Applications

**Frank D. Egitto, Rabindra N. Das, Frank Marconi, W. Wilson  
and Voya R. Markovich**

**Endicott Interconnect Technologies, Inc., 1903 Clark Street,  
Endicott, New York, 13760.**

*Presentation given by: Rabindra Das, Principal Engineer*



# Outline

- **Motivations**
- **Objectives**
- **Approach**
- **Systems studied**
  - ICD & Pacemakers
  - Ultrasound devices
- **Implantable substrates**
  - Stretchable Flex
  - Rigid-Flex
- **Summary**





# Medical Device

**A medical device is a product used for medical purposes in patients, in diagnosis, therapy or surgery**



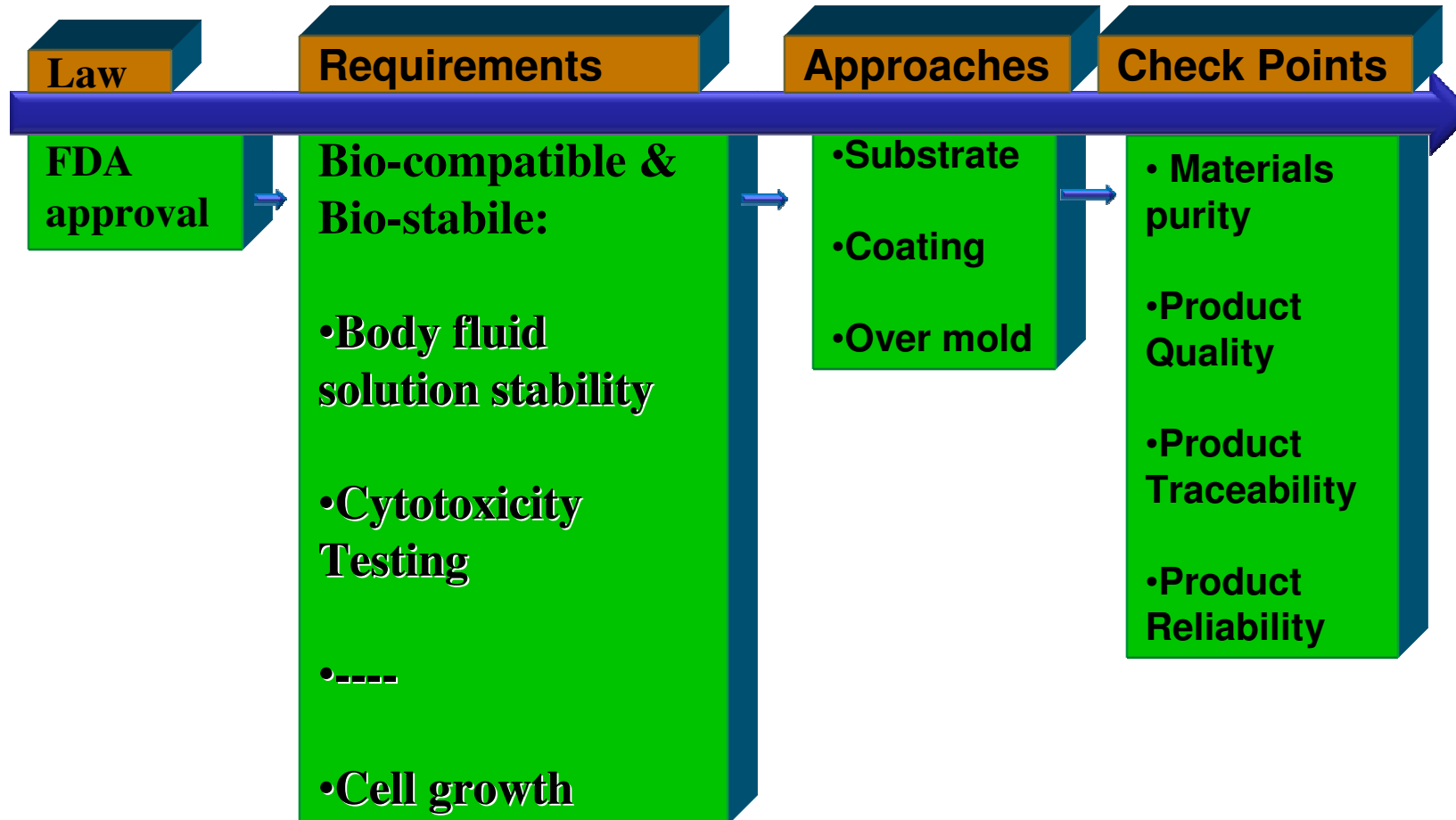


# Objectives

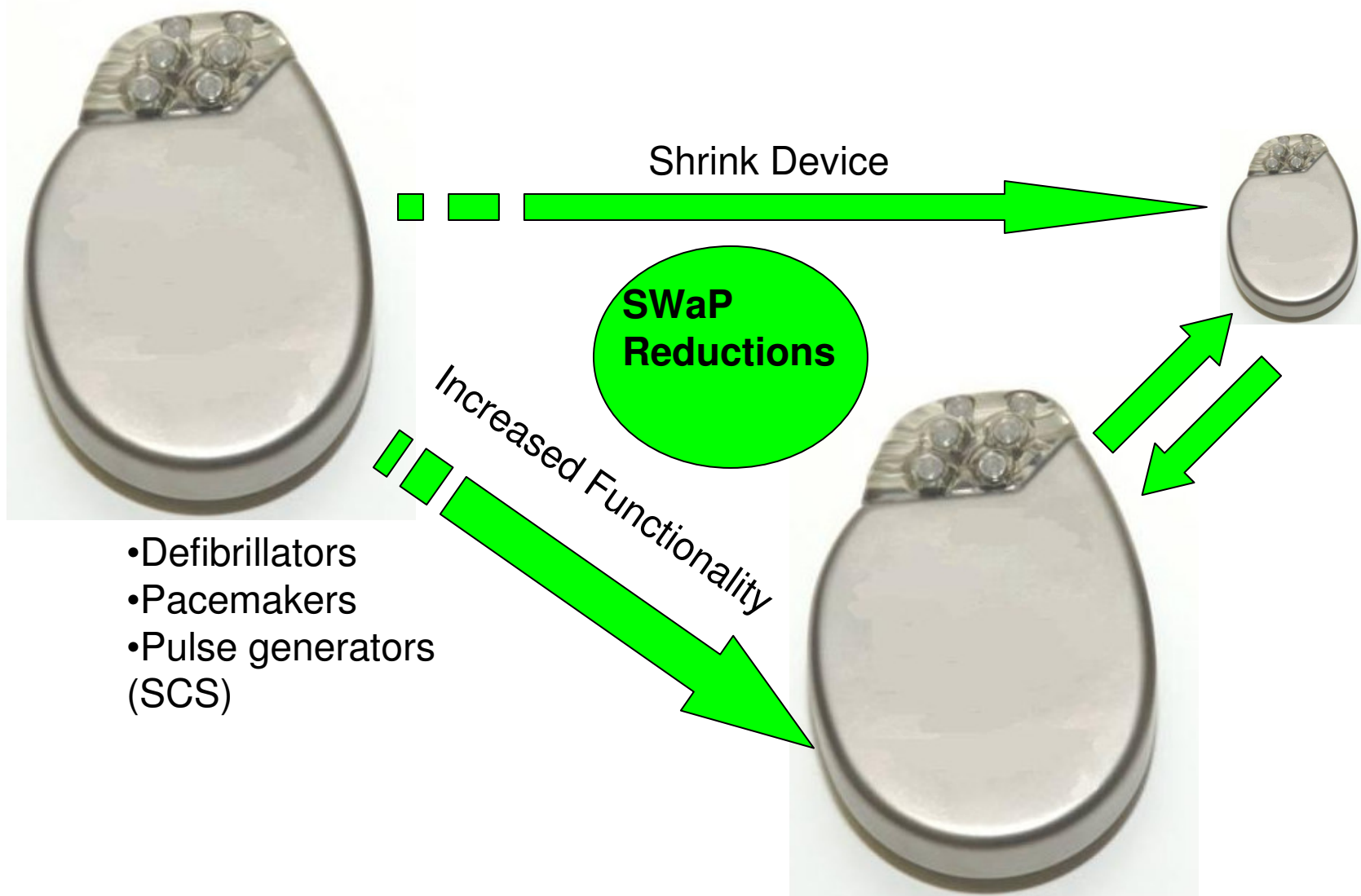
- Develop bio-compatible and or bio-stable shapeless substrates for Conformal Electronics
- Develop flexible Substrates to satisfy space requirements for medical imaging and health monitoring devices
- Develop miniaturized rigid substrate for *SWaP (size, power and weight) advantage*



# Implantable Electronics



# Miniaturized Rigid Substrate





# Ultrasound Device Packaging

## Transducers & Die

- PZT, PLZT, PMN-PT,
- ASIC Die

## Substrate Fabrication

- 25  $\mu\text{m}$  laser drilled vias (minimum)
- 12/12 $\mu\text{m}$  line width & space (minimum)

## IC Assembly

- Flip chip pitch down to 70  $\mu\text{m}$  (minimum)
- Piezoelectric Crystal assembly

## Module Tester

- Full functional module test



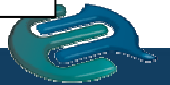
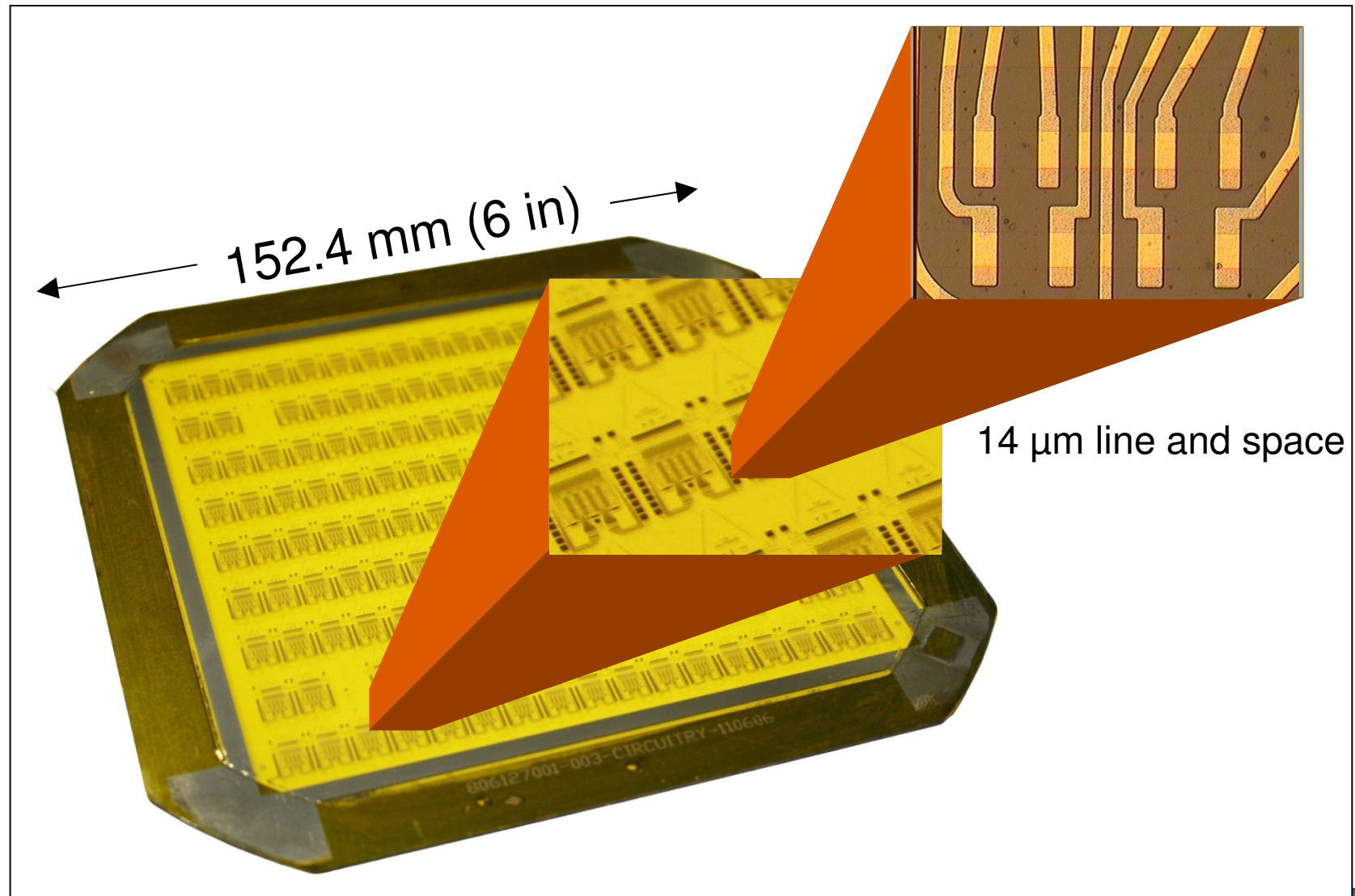
# Intravascular Ultrasound Catheter Sensor Package



- **Intravascular Ultrasound (IVUS)** is a catheter- based system that allows physicians to acquire images of diseased vessels from inside the artery. IVUS provides detailed and accurate measurements of lumen and vessel size, plaque area and volume, and the location of key anatomical landmarks.

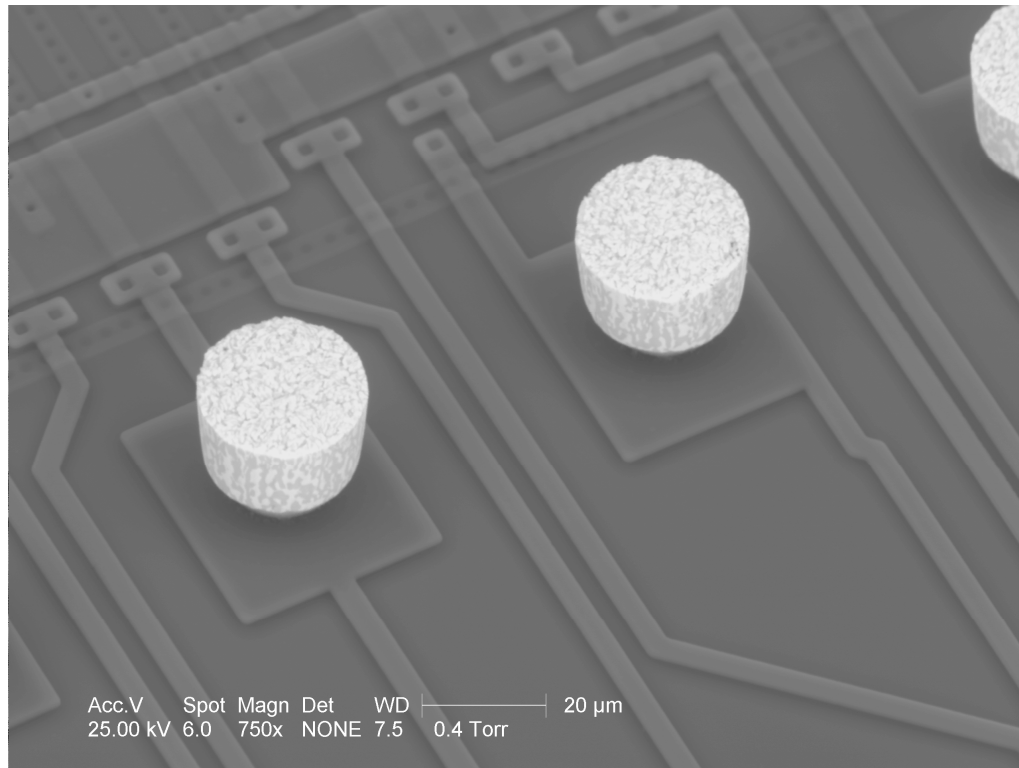


# Intravascular Ultrasound Catheter Manufacturing





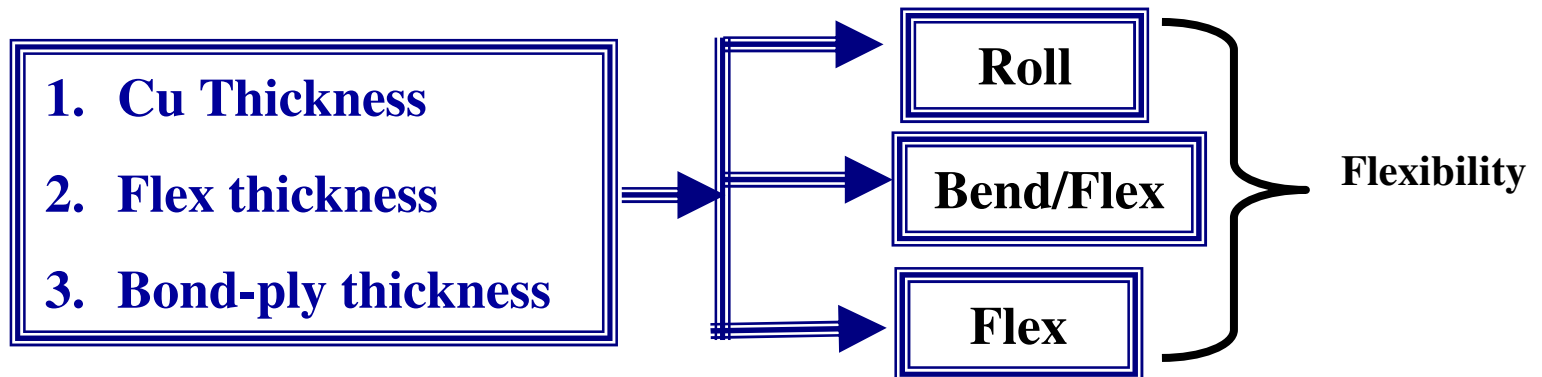
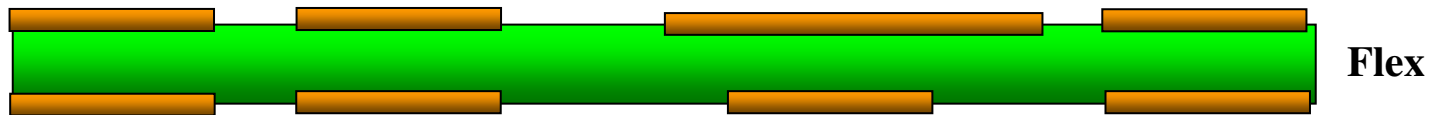
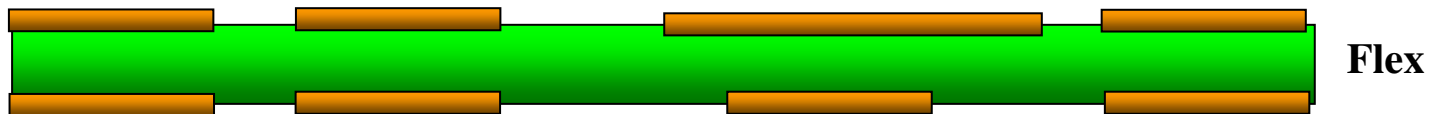
# Micro Pillar Technology for Finer Pitch applications



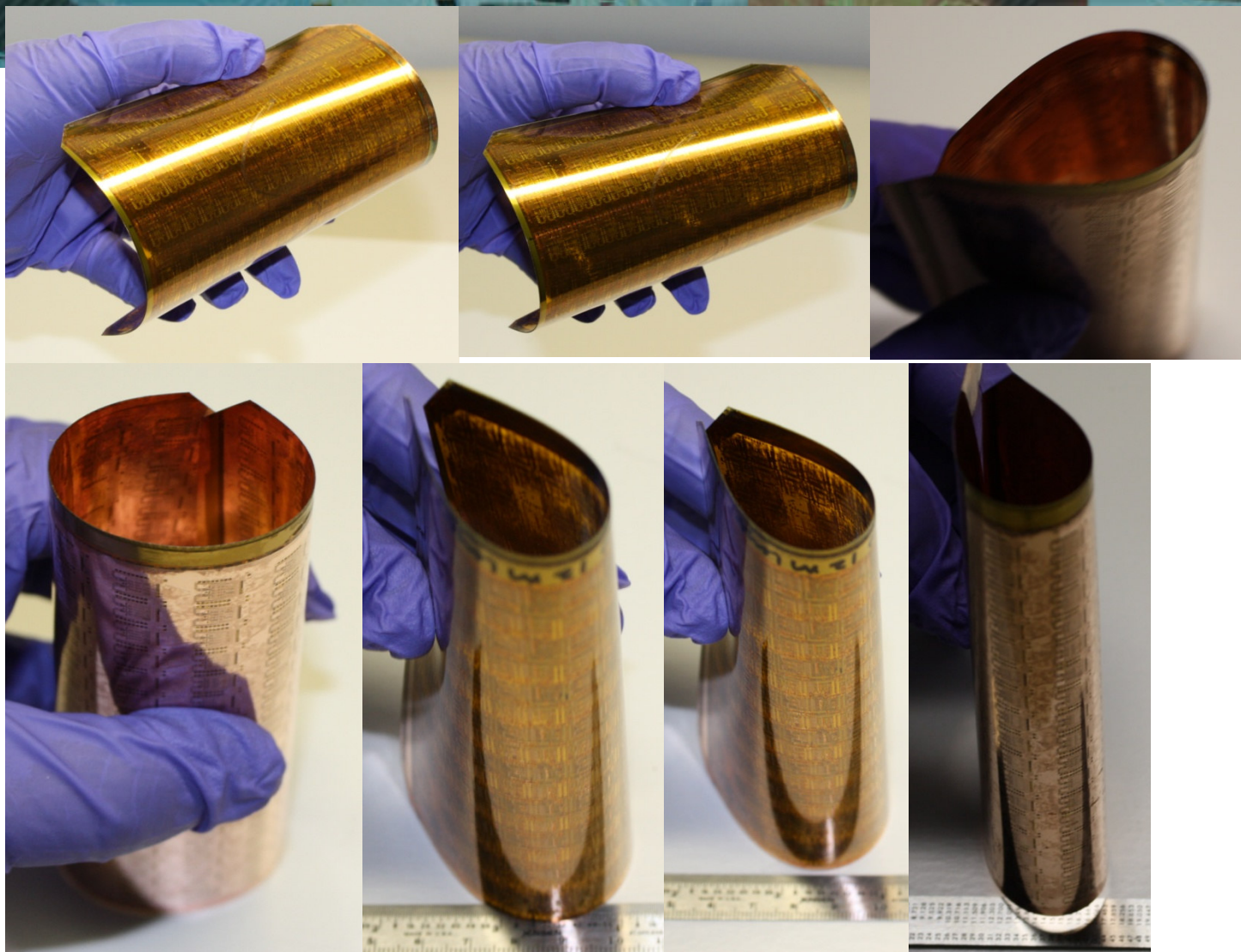
ASIC die with 70 μm bonding pad pitch



# Multilayer Flex



# Multilayer Flex

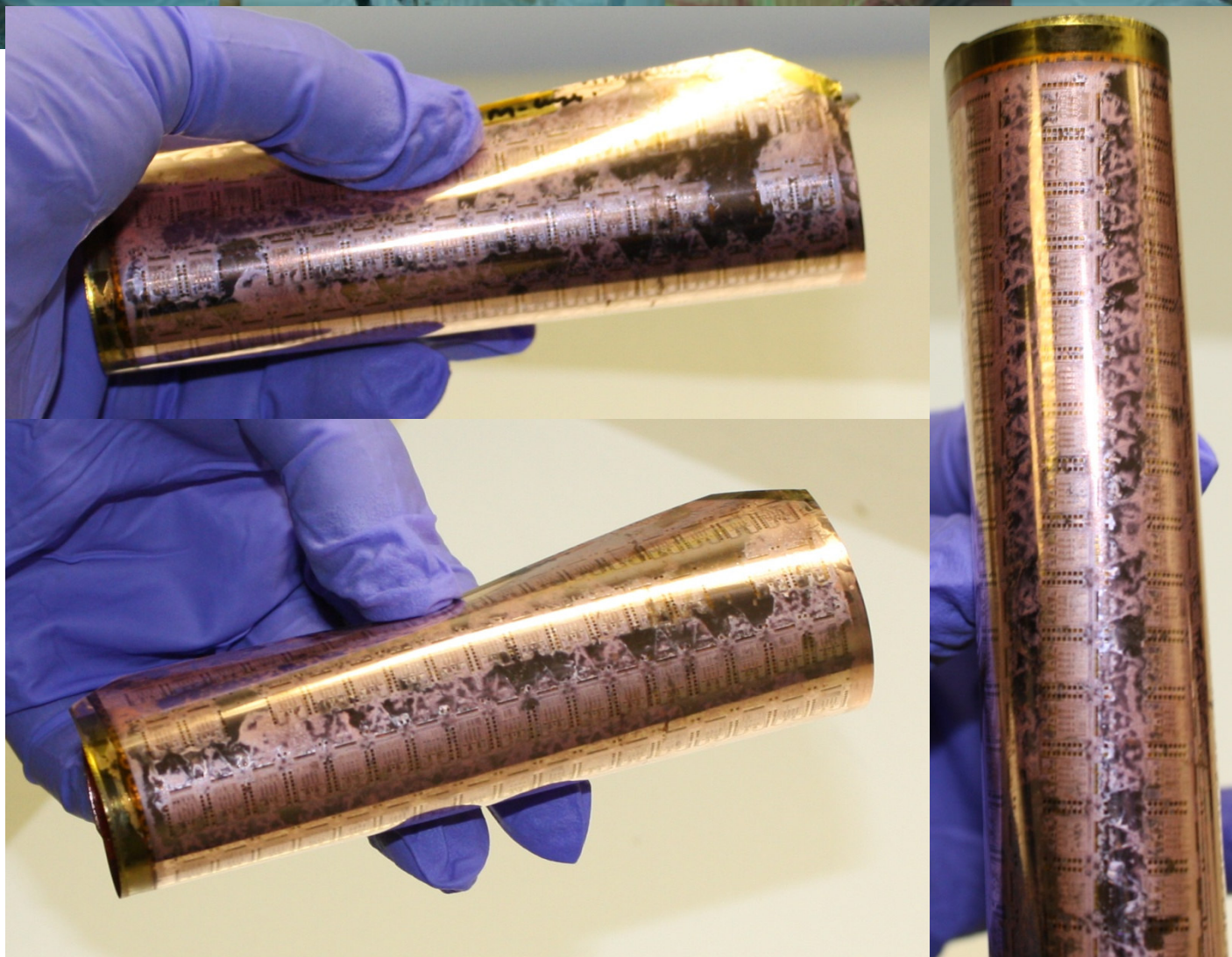


**12 metal layers, 12.8-13 mils thick, bend radius 1 inch or higher**





# Multilayer Flex

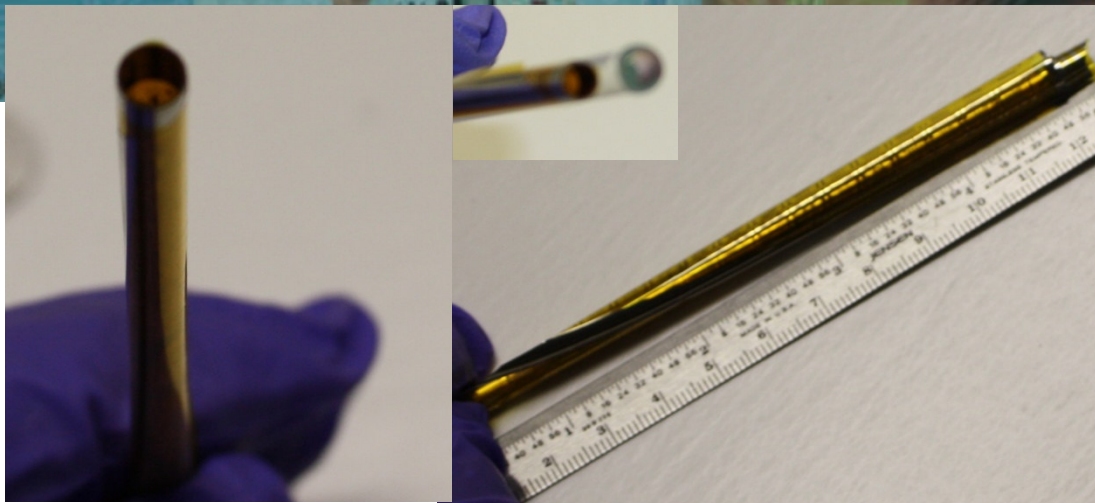


**12 metal layers, 7.5 mils thick, bend radius 1 inch or less**

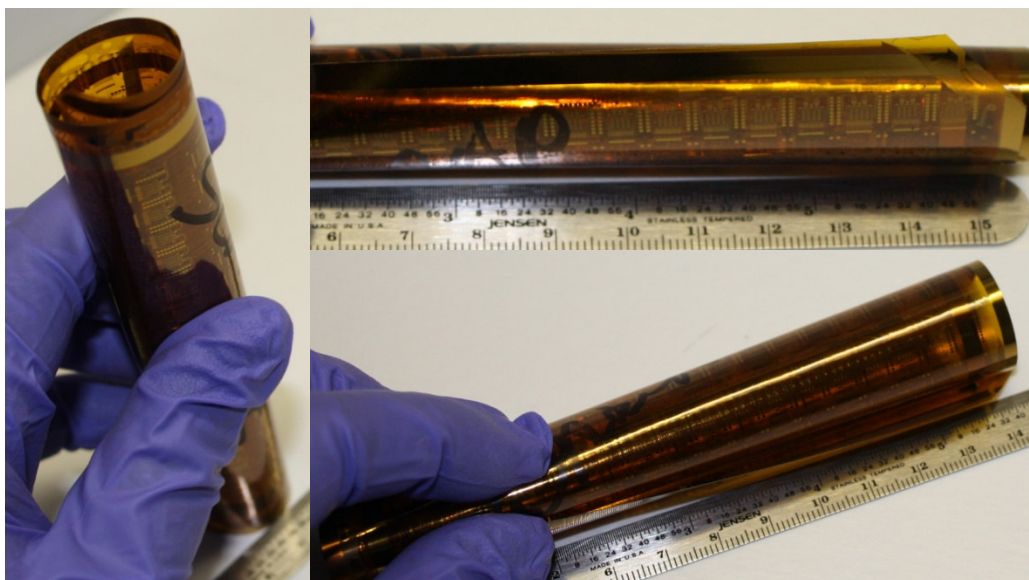




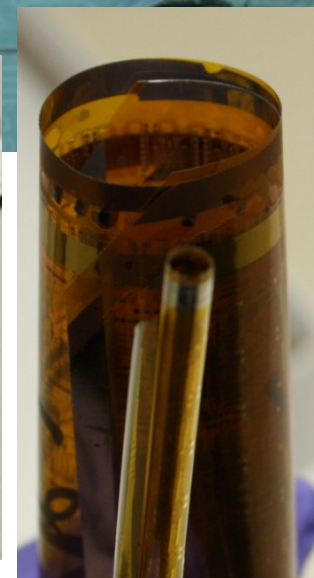
# Multilayer Flex



**2 metal layers, ~1 mil thick, Roll diameter: 180 mils**



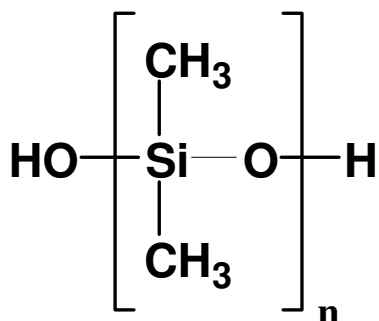
**6 metal layers, ~5 mils thick**



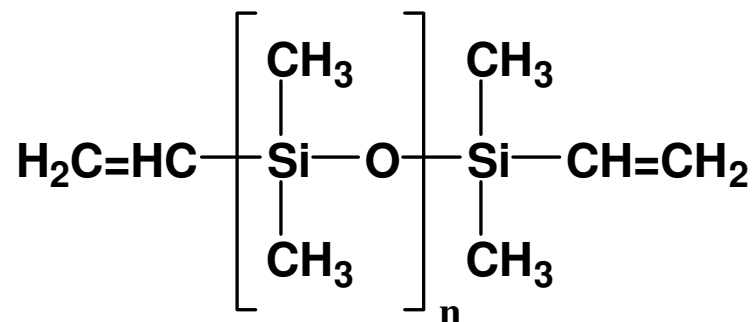


# Silicones

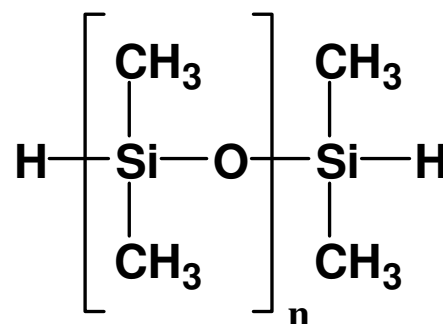
*PDMS Base Resins*



**Silanol-Terminated PDMS**



**Vinyl-Terminated PDMS**



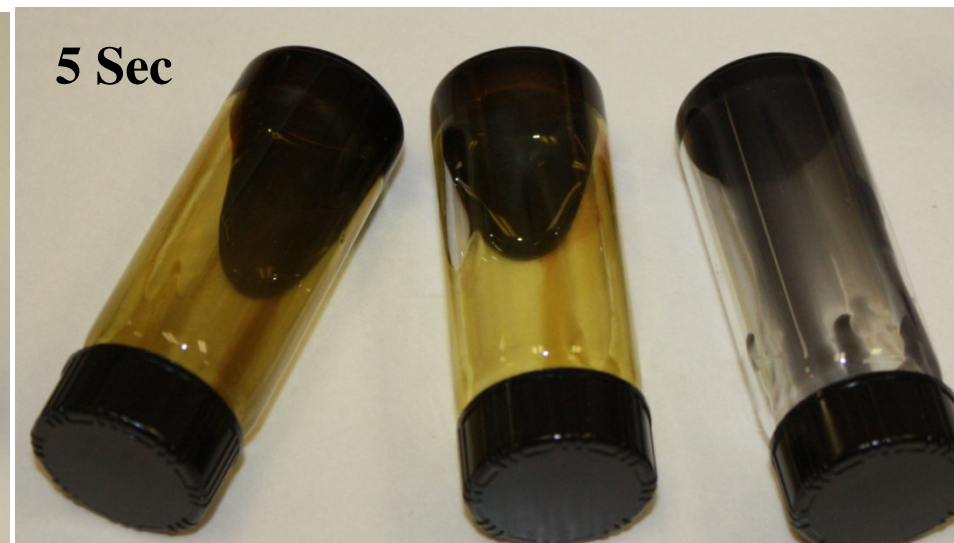
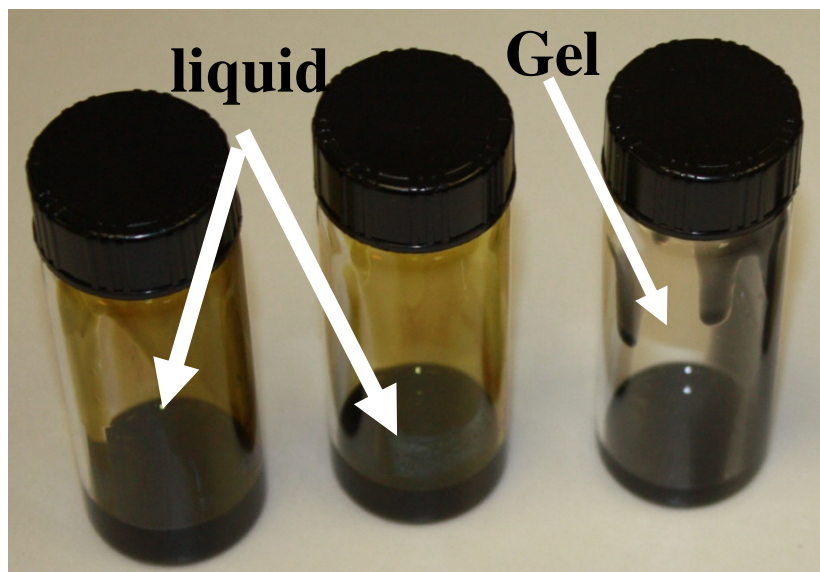
**Silane-Terminated PDMS**

- **Molecular weight of Polymer**
- **Curing Chemistry**





# Thermal Interface Materials (TIM): Nanogels

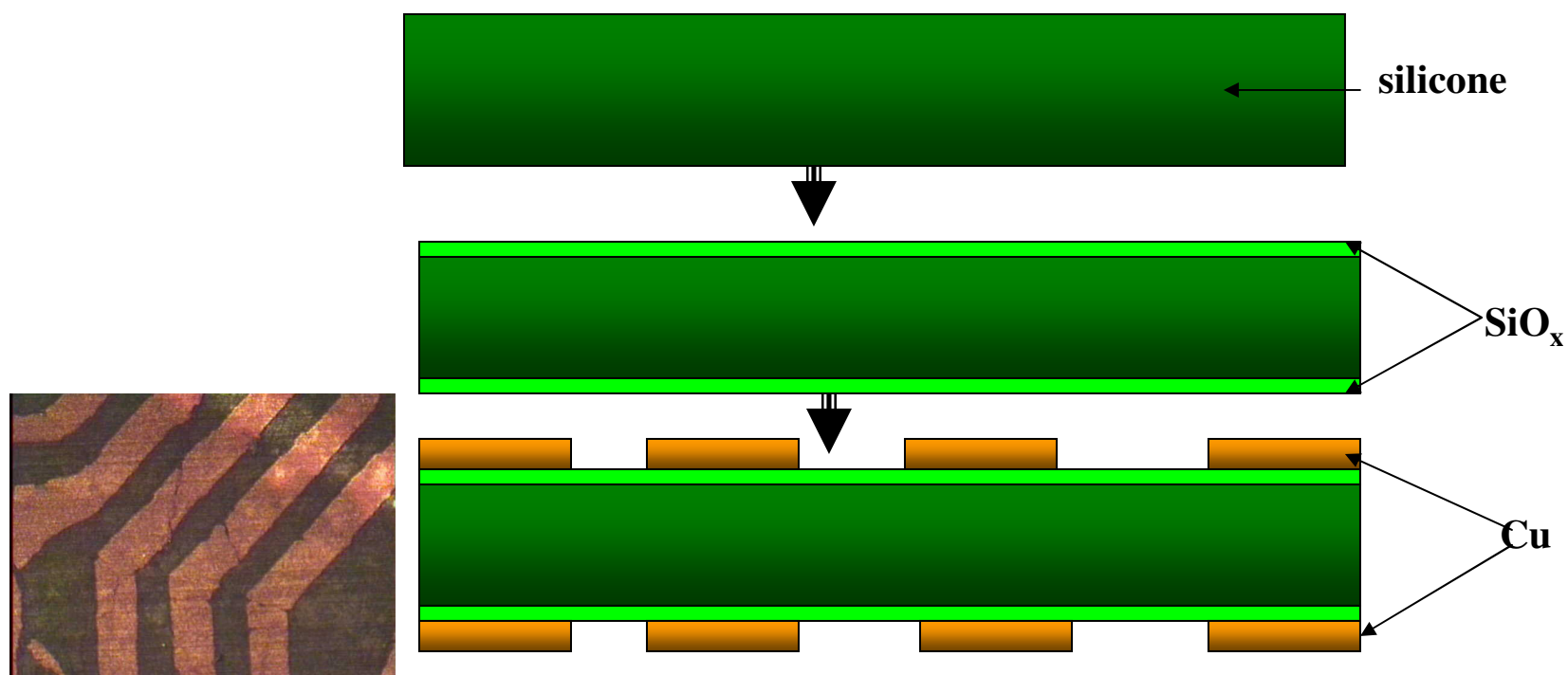


- Molecular level of Mixing  
(4-25% metal nanoparticle)
- Tune viscosity/flow for  
TIM applications

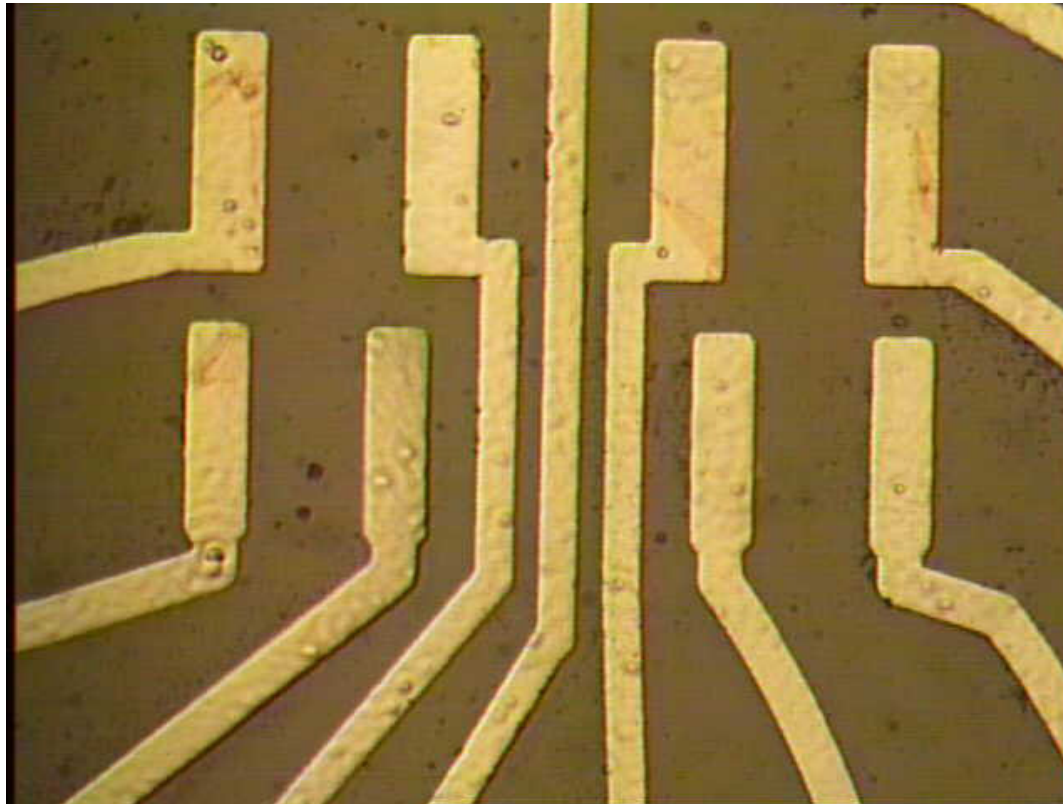


# Shapeles Electronics

- Bio-compatible
- Bio-stable
- Fine lines



# Water soluble PVA Substrate







# Summary

## **EI developed variety of Substrate technology for a host of applications including:**

- Pacemakers
- Implantable cardioverter defibrillators (ICD)
- Ultrasonic catheters
- LED surgical overhead and endoscope lighting
- Digital x-ray
- Patient monitoring systems
- CT scan
- Supercomputing for life science simulation (drug design)

## **Extending development to other implantable applications**

- Conformal electronics
- Pulse generator

