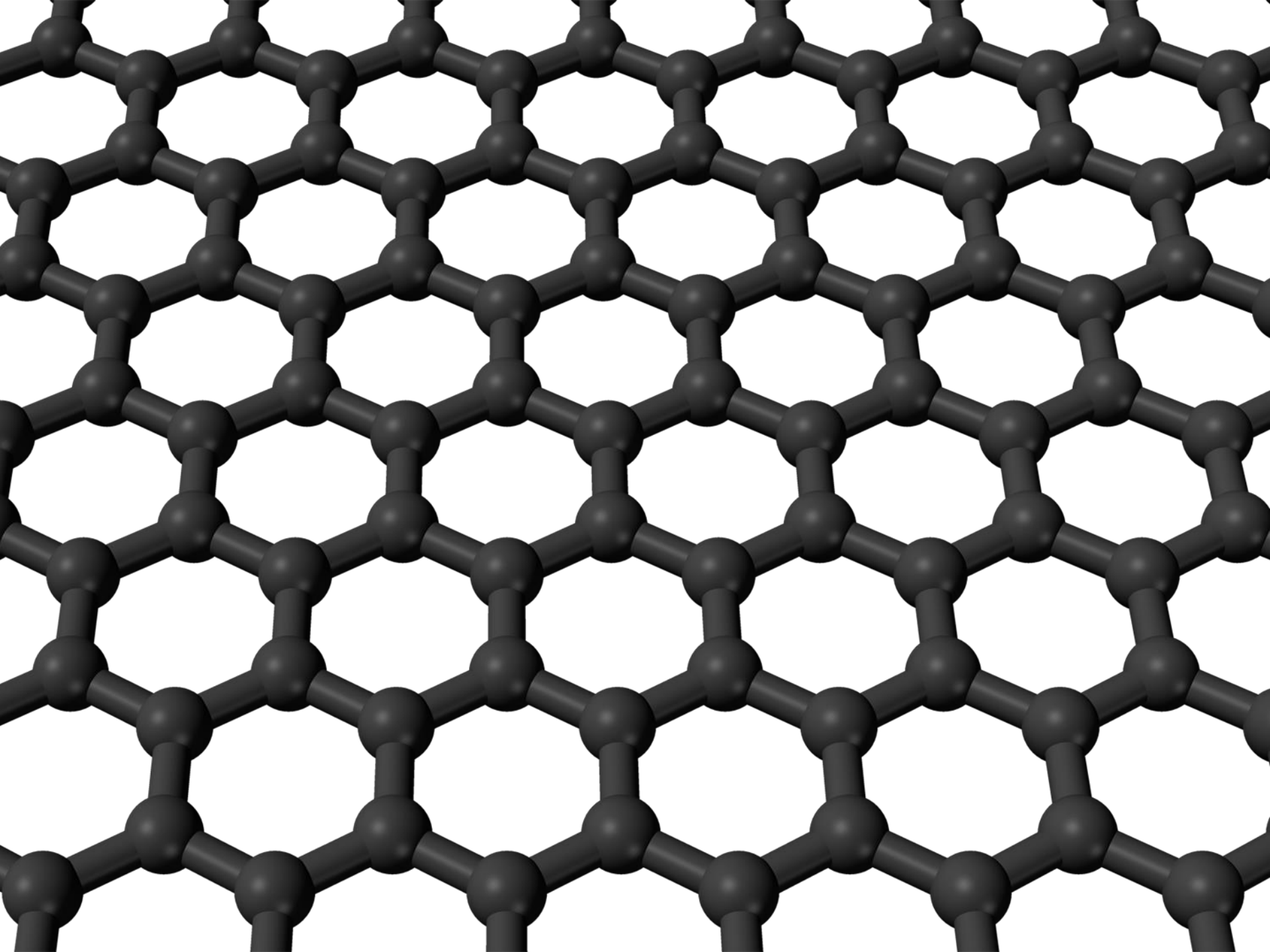




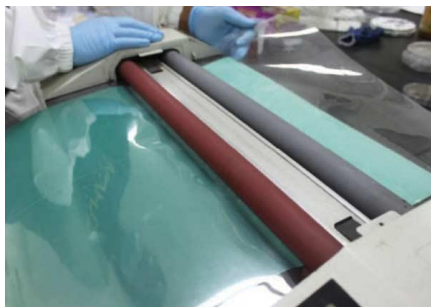
Graphene Frontiers

Mike Patterson – CEO
graphenefrontiers.com



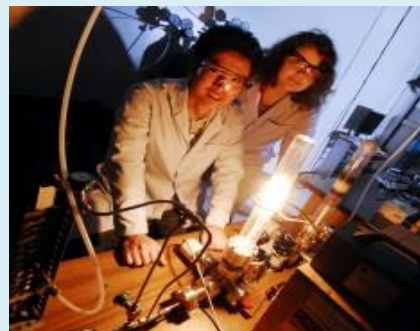


Chemical Vapor Deposition (CVD)

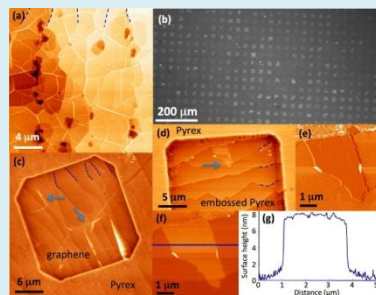


Large Area Sheets

- Displays
- Touch Screens
- Solar
- Thermal Mgmt

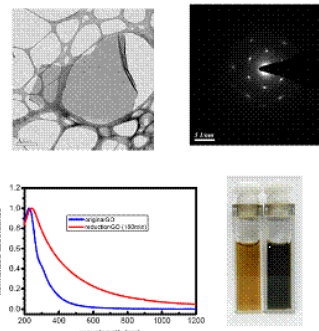


Epitaxial Growth (Thermal Decomposition)



Small Area Crystals

- Circuits
- Interconnects
- Memory
- Semiconductor

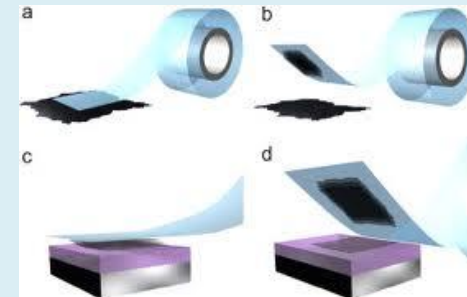


Reduced Graphene Oxide From Solution

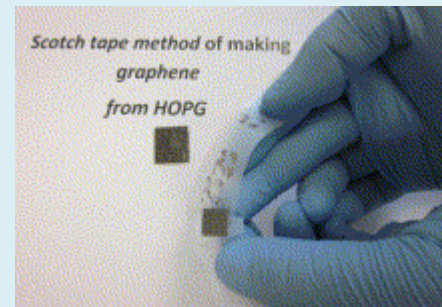


Powder (GNP)

- Paints
- Batteries
- Polymers
- Capacitors



“Scotch Tape” Exfoliation

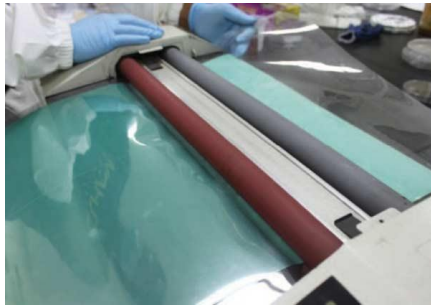


Flakes

- Research



Chemical Vapor Deposition (CVD)

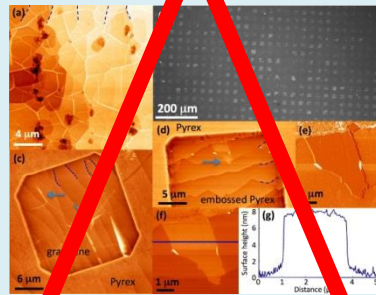


Large Area Sheets

- Displays
- Touch Screens
- Solar
- Thermal Mgmt

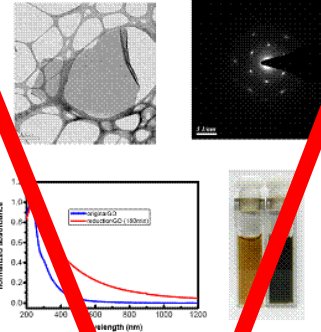


Epitaxial Growth (Thermal Decomposition)

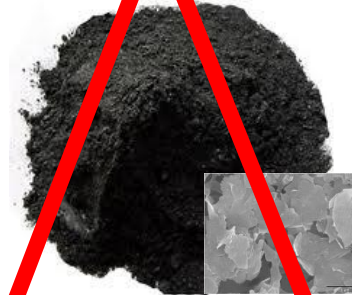


Small Area Crystals

- Circuits
- Interconnects
- Memory
- Semiconductors

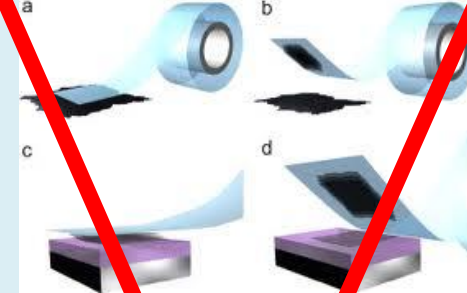


Reduced Graphene Oxide From Solution

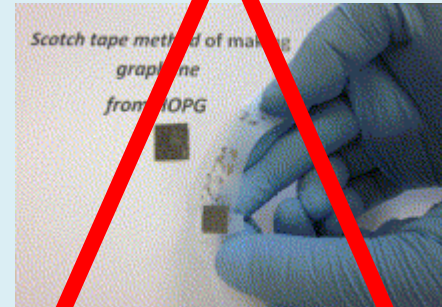


Powder (GNP)

- Paints
- Polymers
- Batteries
- Capacitors



"Scotch Tape" Exfoliation



Flakes

- Research

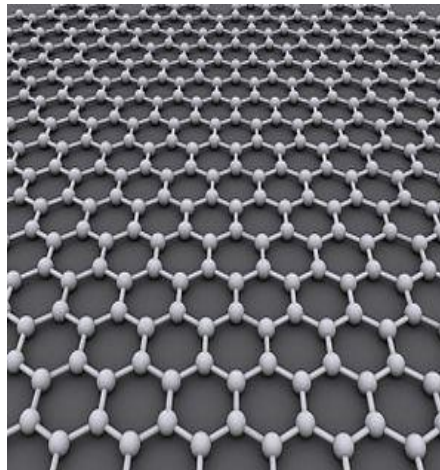
Graphene: Super Material

“Graphene is an allotrope of carbon and its 2D structure measures just one atom thick. While being thin, it’s the strongest material ever tested, having a breaking strength 200 times greater than steel and is also the lightest material ever, best intrinsic conductor and super-flexible, too. It's predicted to replace silicon as the base for all electronics.”

-- 6/14/2011 Nokia Corp. Blog Post

Graphene’s amazing properties:

- Electrical: Electron mobility > $15,000 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$
- Thermal: Room temp conductivity > $5000 \text{ Wm}^{-1}\text{K}^{-1}$
- Optical: Colorless, no haze, $T = 97.7\%$ transparency
- Mechanical: Flexible, non-brittle, stiffness of 1 Tpa



Graphene Fast Facts:

- Three million sheets of graphene on top of each other would be 1mm thick
- In 2004, Andre Geim and Konstantin Novoselov demonstrated that single layers could be isolated, resulting in the award of the Nobel Prize for Physics in 2010

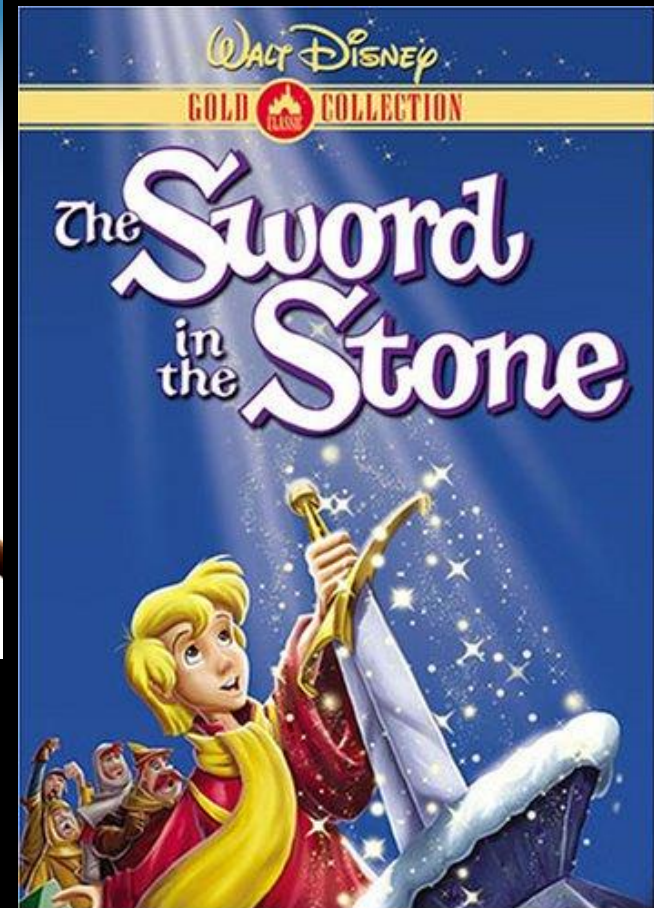
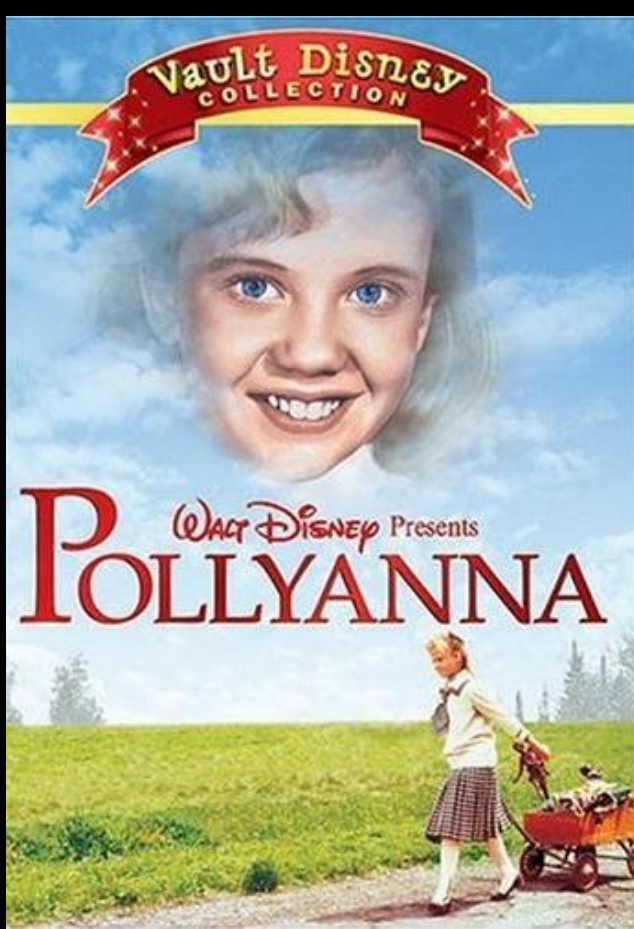
--from: news.bbc.uk



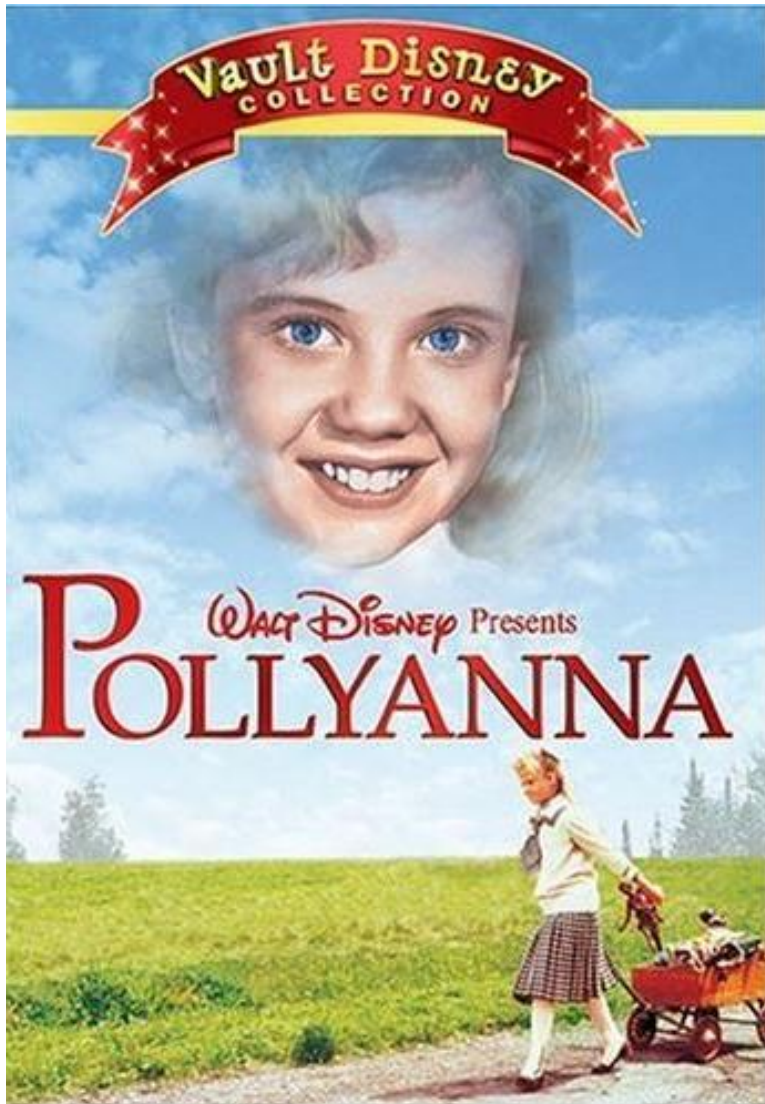
ALFR.
NOBEL

NAT.
MDCCC
XXXIII
OB.
MDCCC
XCVI

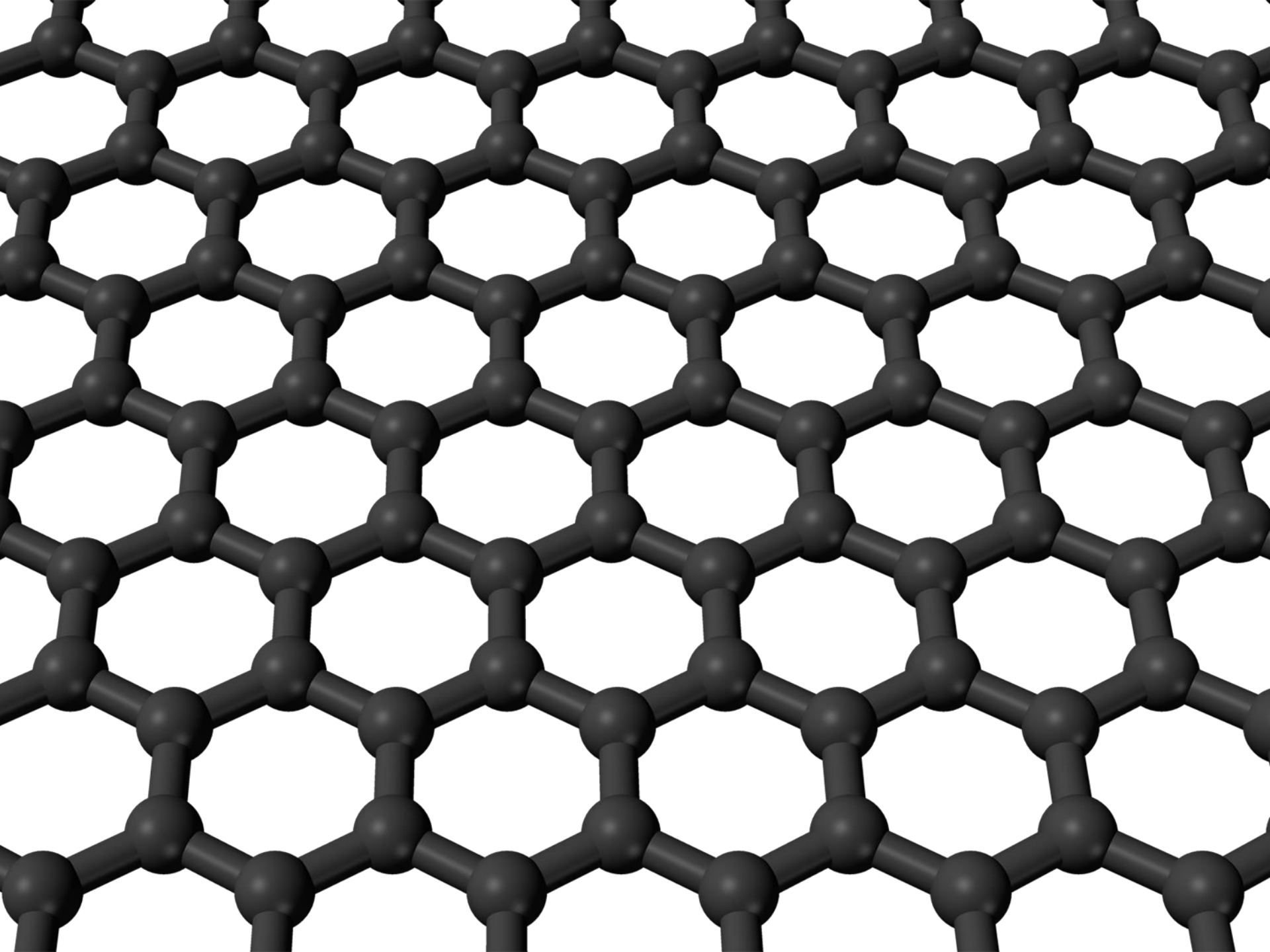
E. LINDBERG 1902



Chapter 1:



In 1978 researchers Margaret Matlin and David Stang provided substantial evidence of the Pollyanna Principle. They found that people expose themselves to positive stimuli and avoid negative stimuli, they take longer to recognize what is unpleasant or threatening than what is pleasant and safe, and they report that they encounter positive stimuli more frequently than they actually do.



Strong

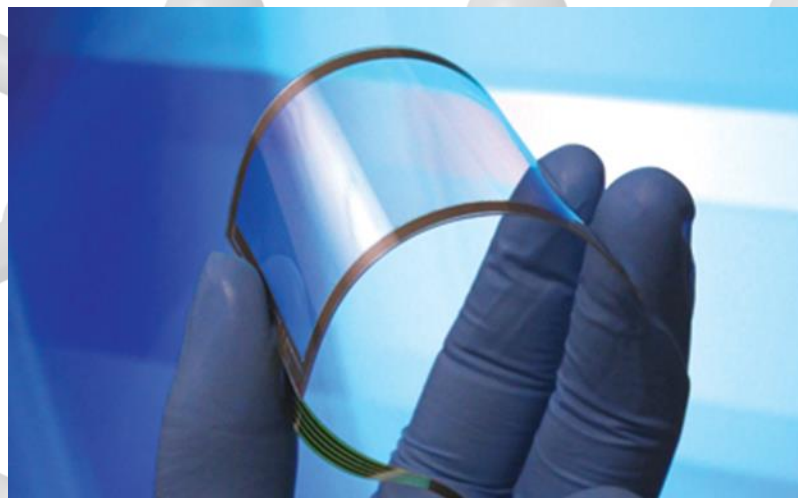


10x



100x

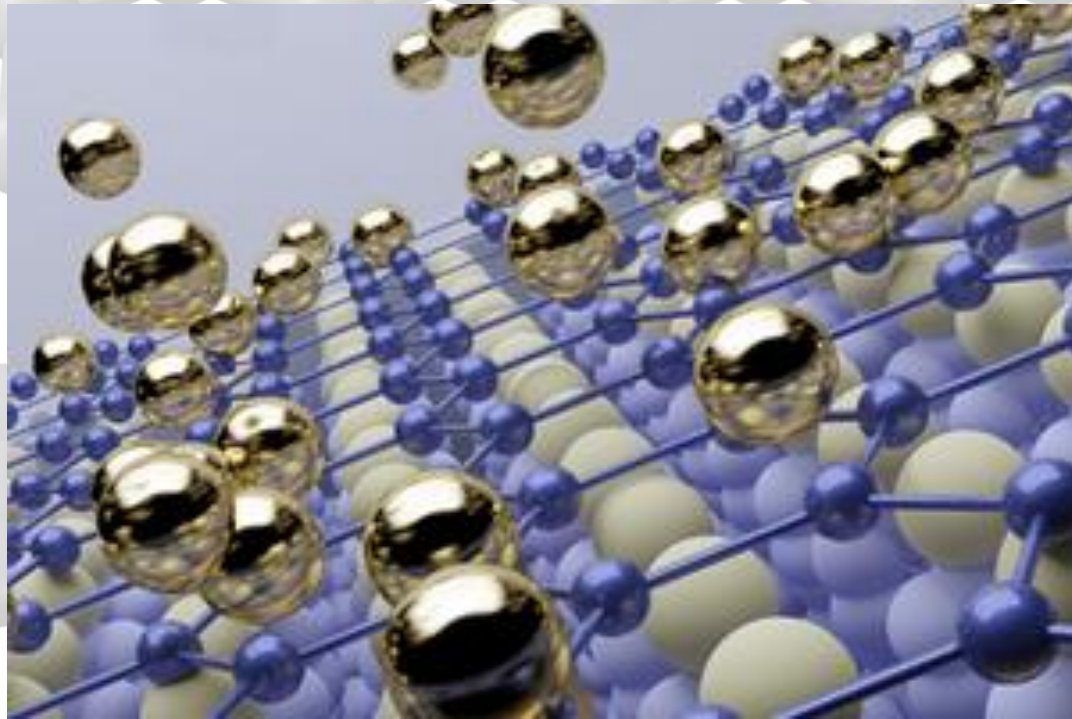
Flexible



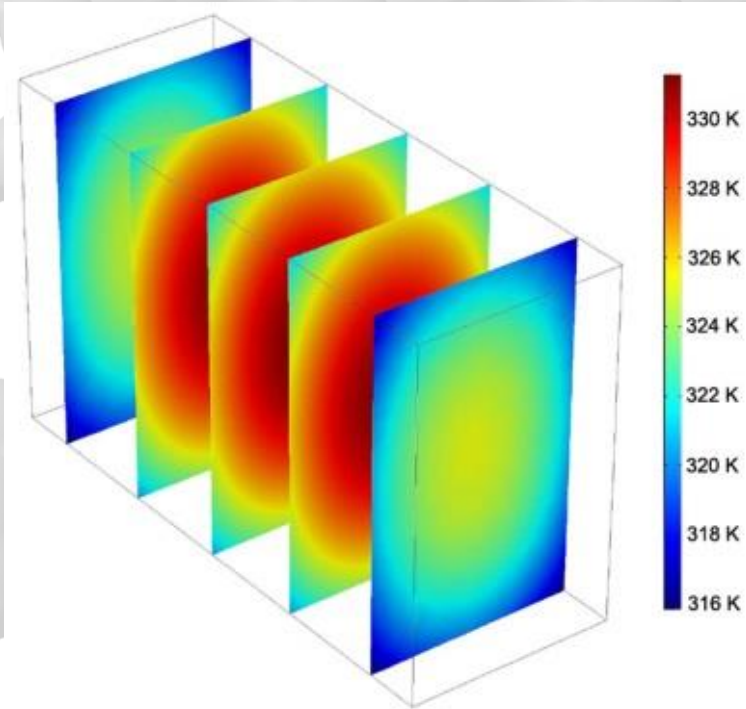
Transparent



Impermeable



Conductive



Heat



Electricity



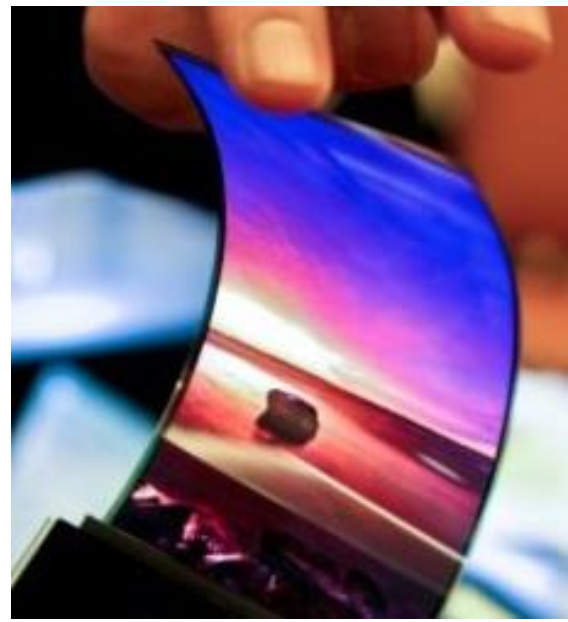
Strong

Flexible

Transparent

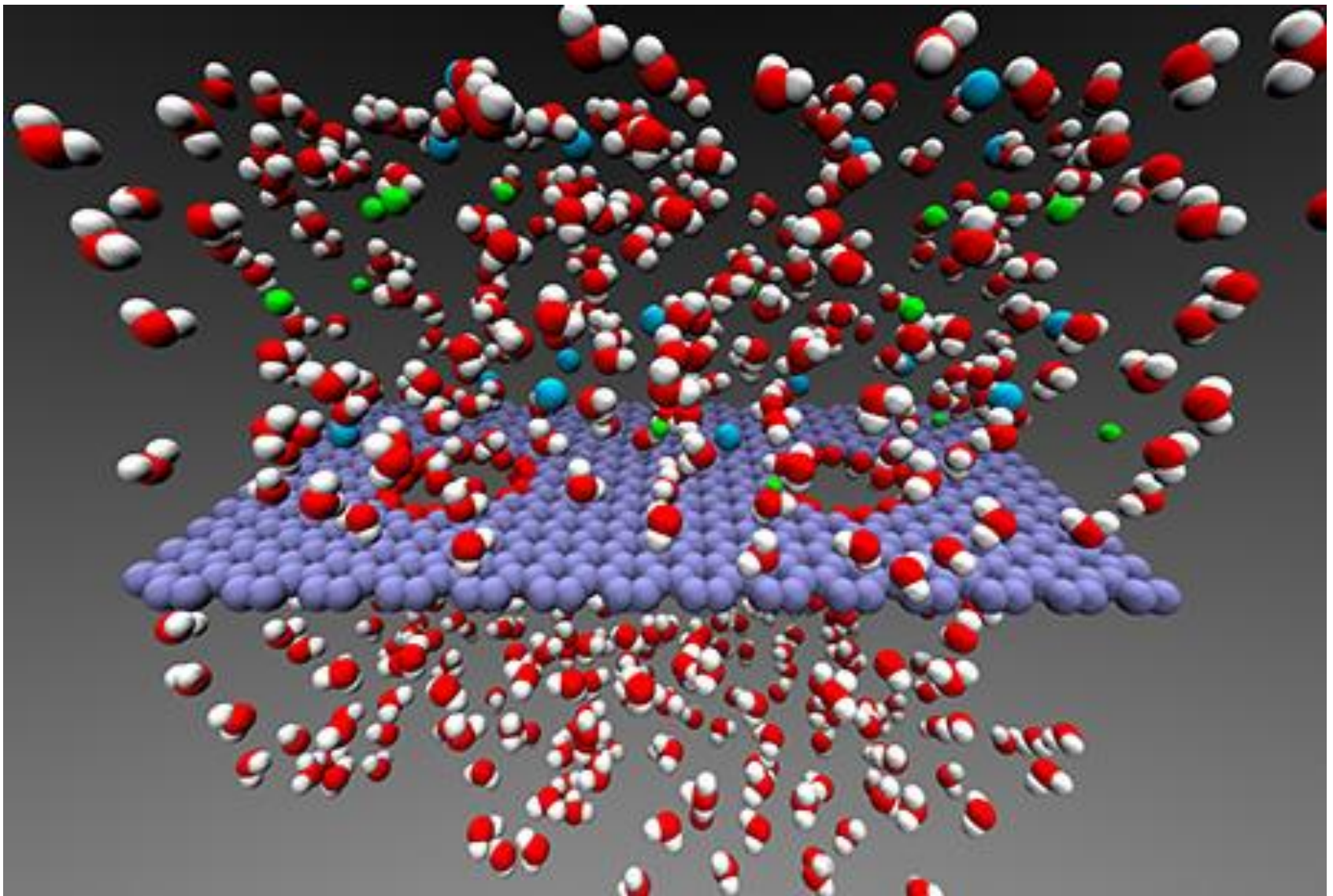
Impermeable

Conductive



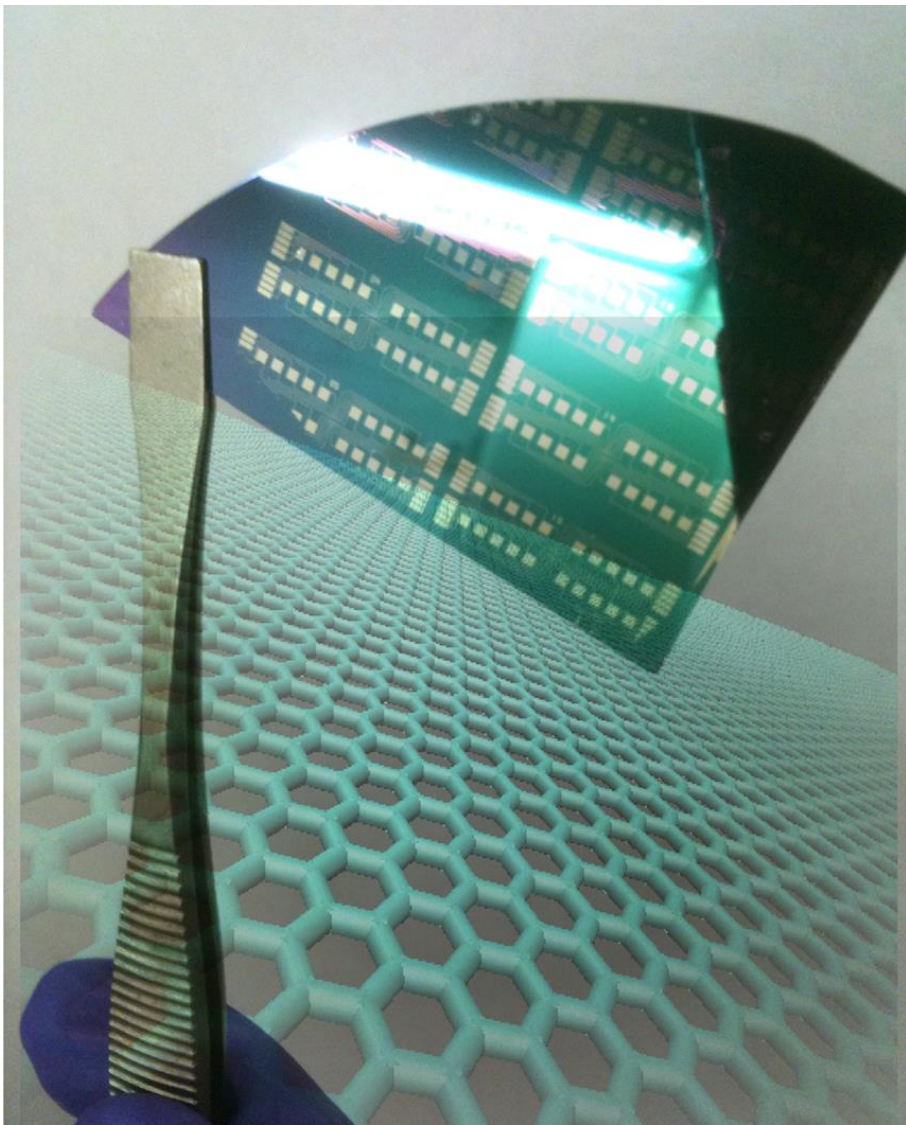
Flexible Electronics:

\$8.2B



Desalination:

\$2.7B



Sensors:



\$6.4B

Problem: Commercial Production



1) Low Volume

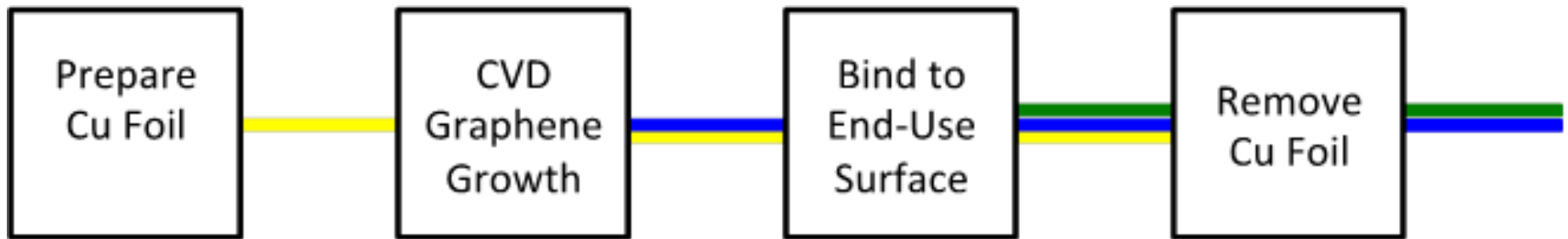
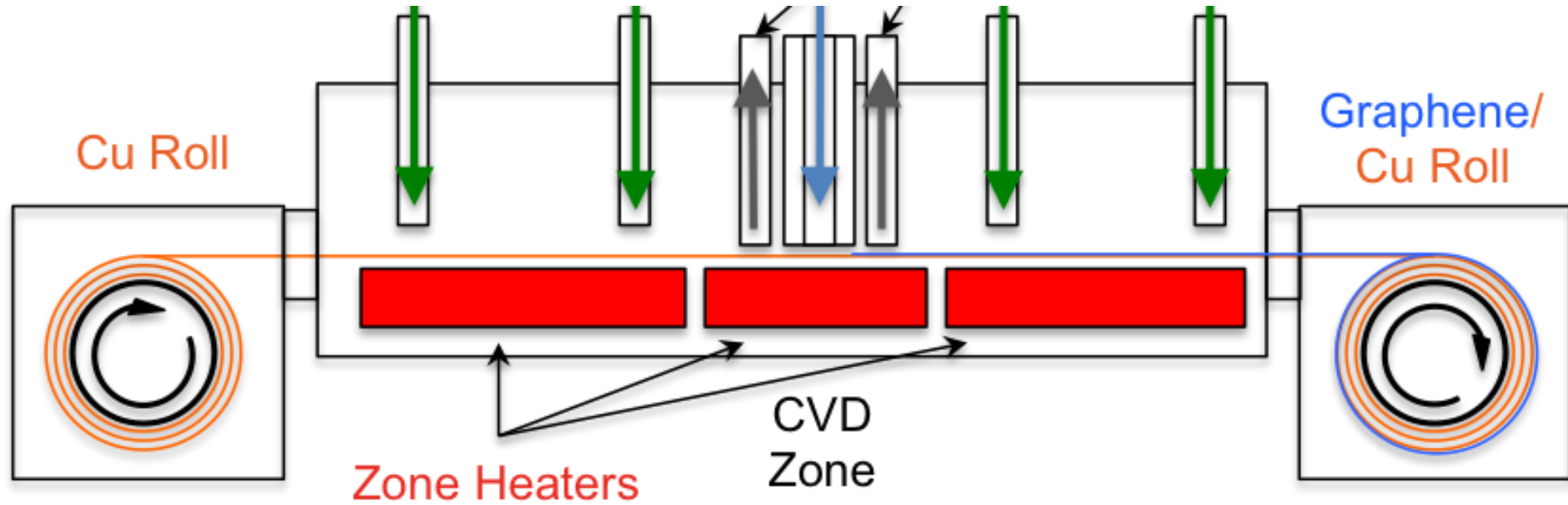
2) Expensive

3) Not Uniform

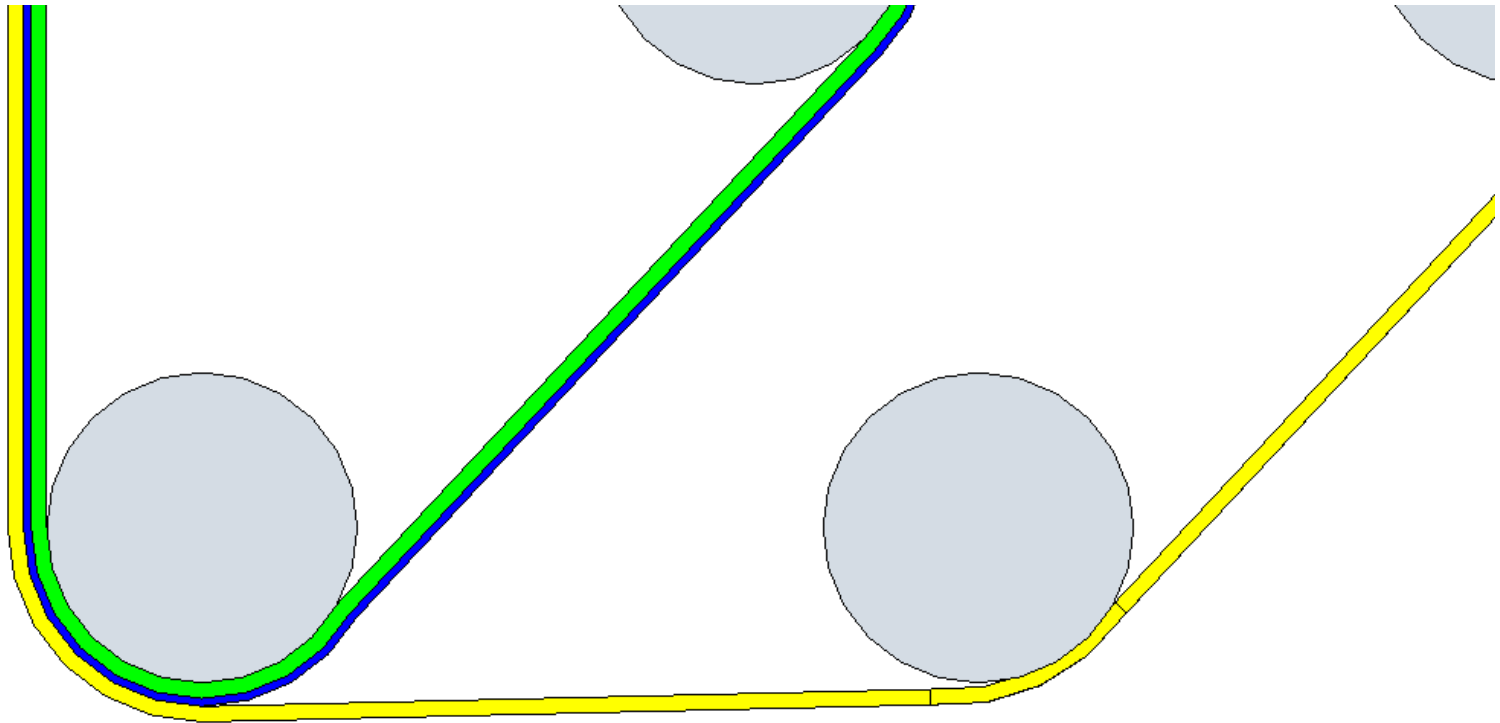
4) Harsh Chemicals

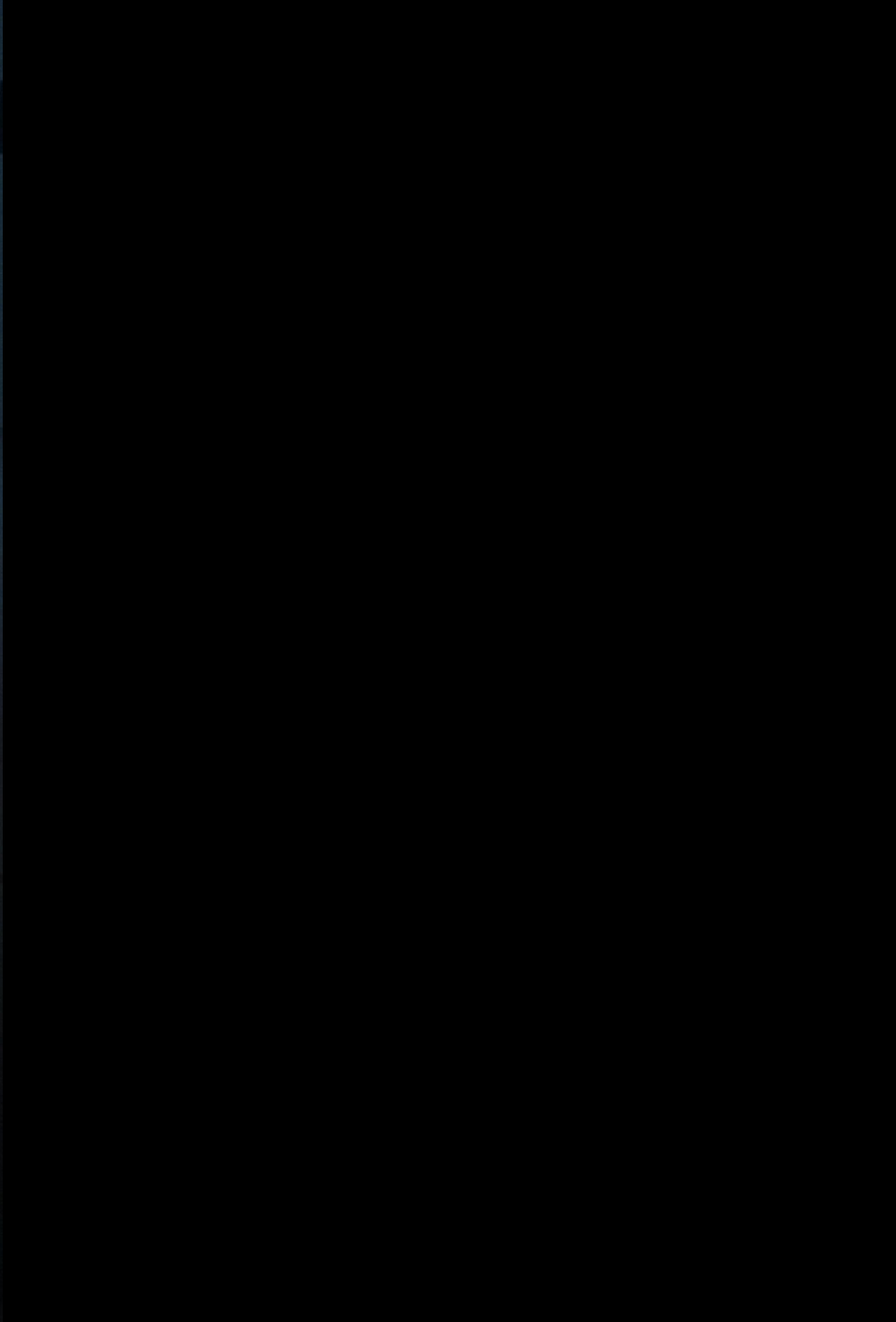


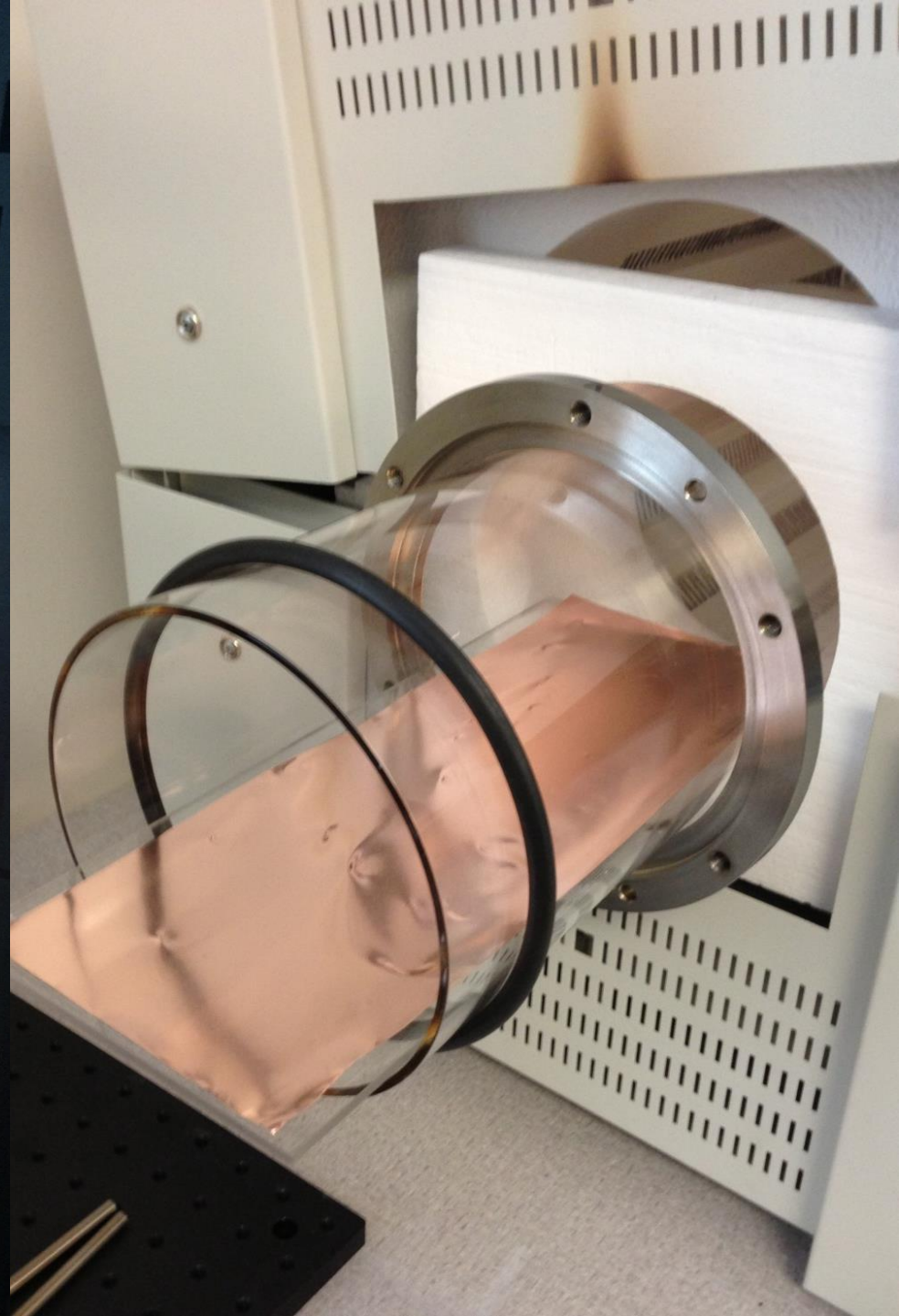
Breakthrough: Problem Solved



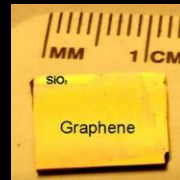
Breakthrough: Problem Solved







2010



1 cm² > \$10,000

2012



1 cm² < \$10

2014



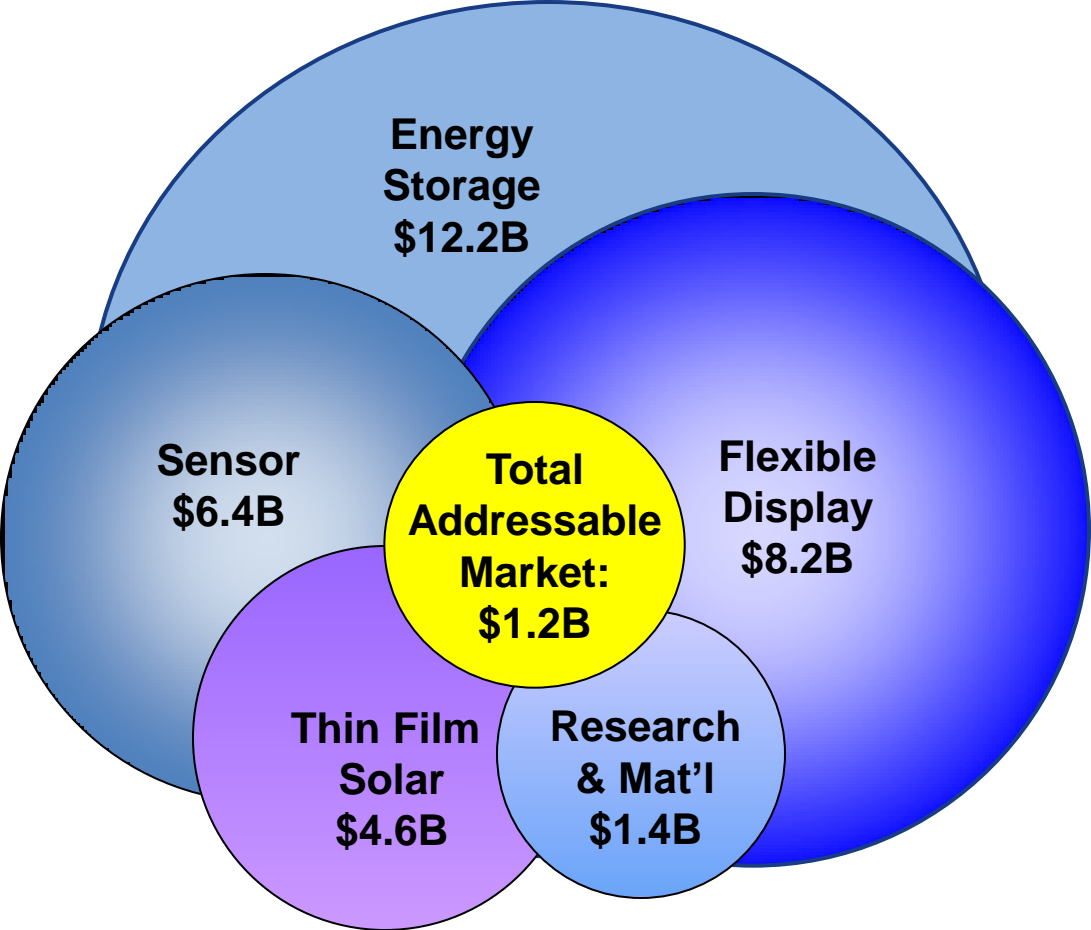
1 cm² < \$.01

Chapter 2:

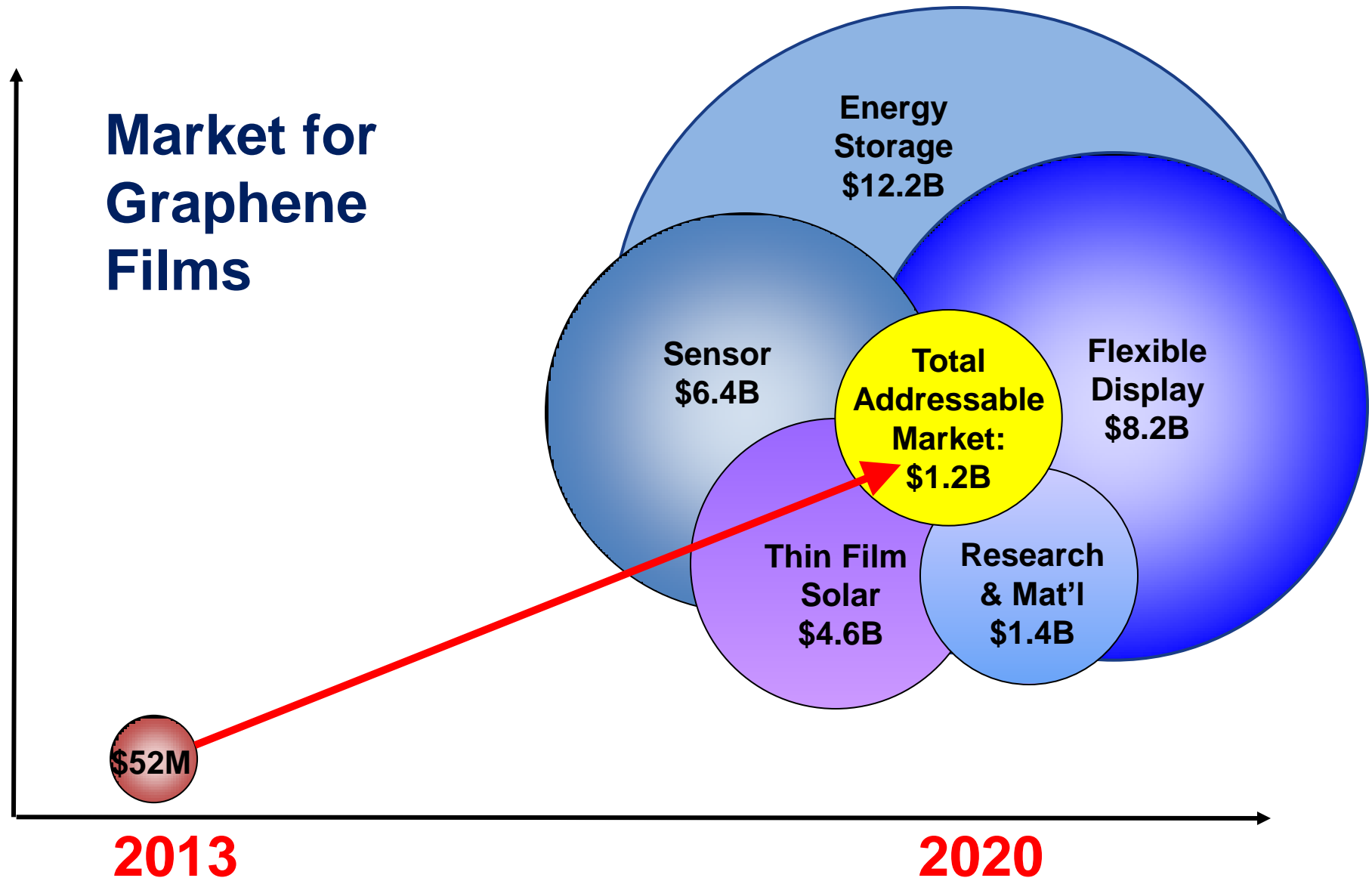


The sky is falling.

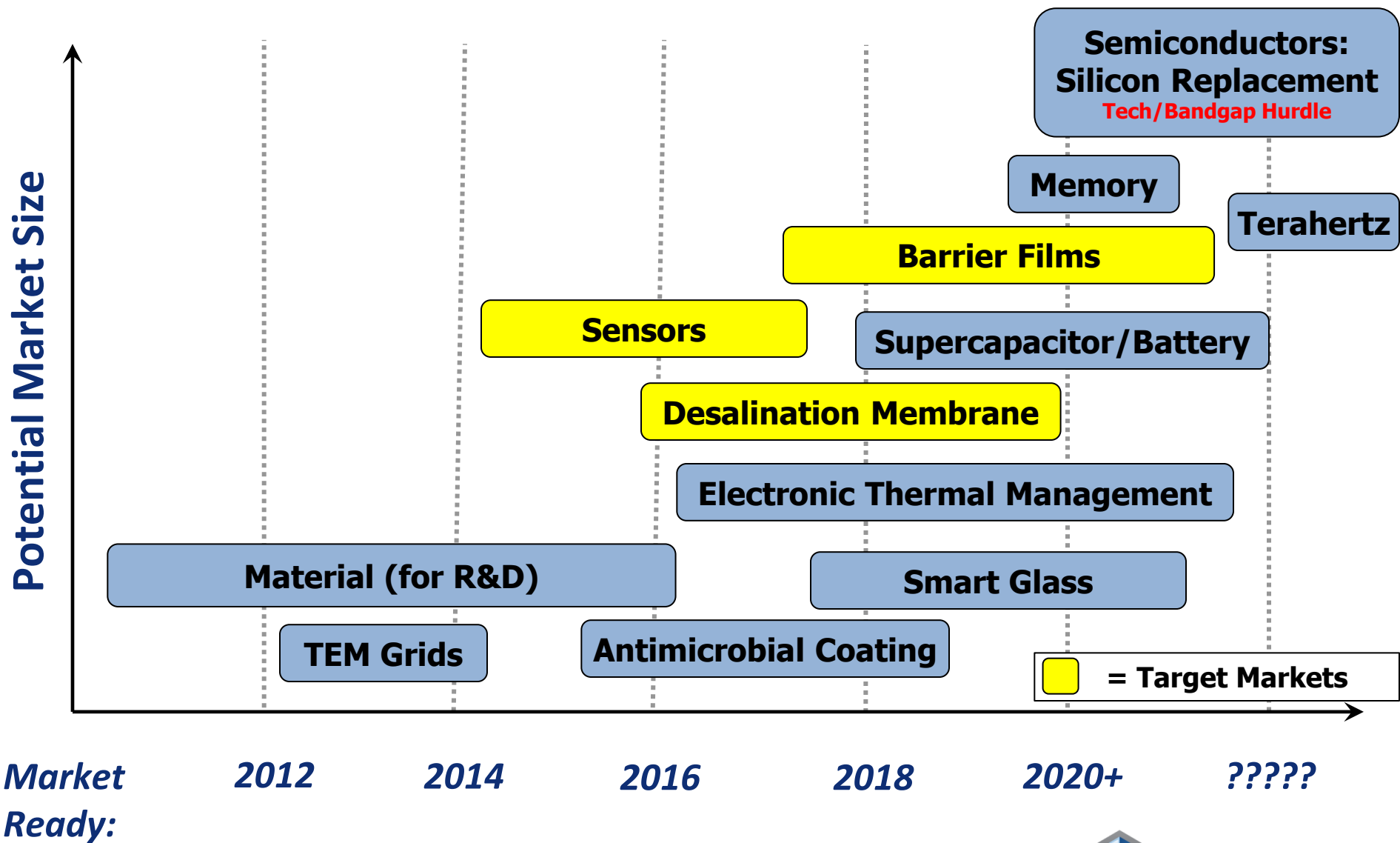
Market for Graphene Films



Reality: **Slow to Market**



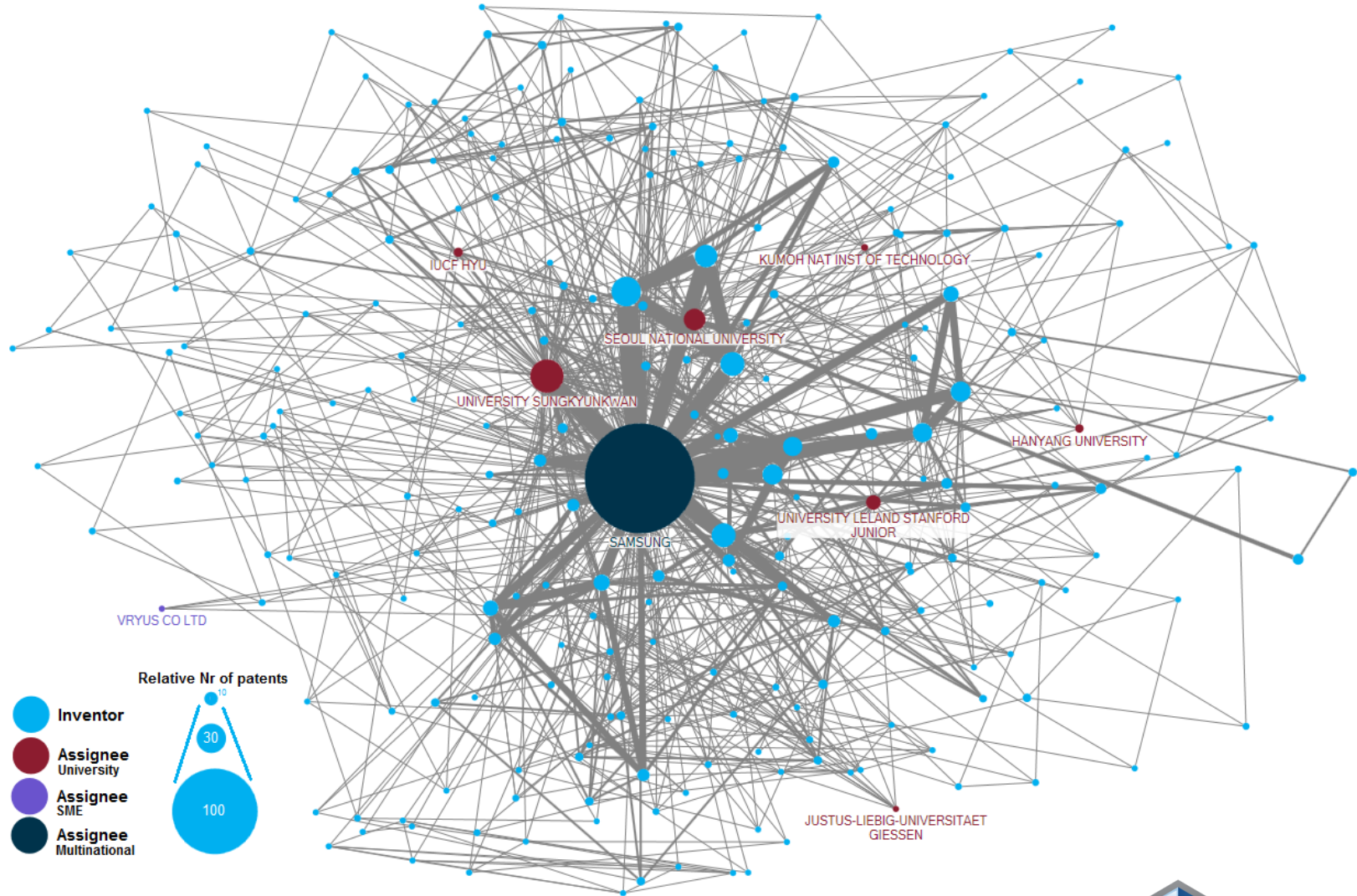
Markets: Size and Timing

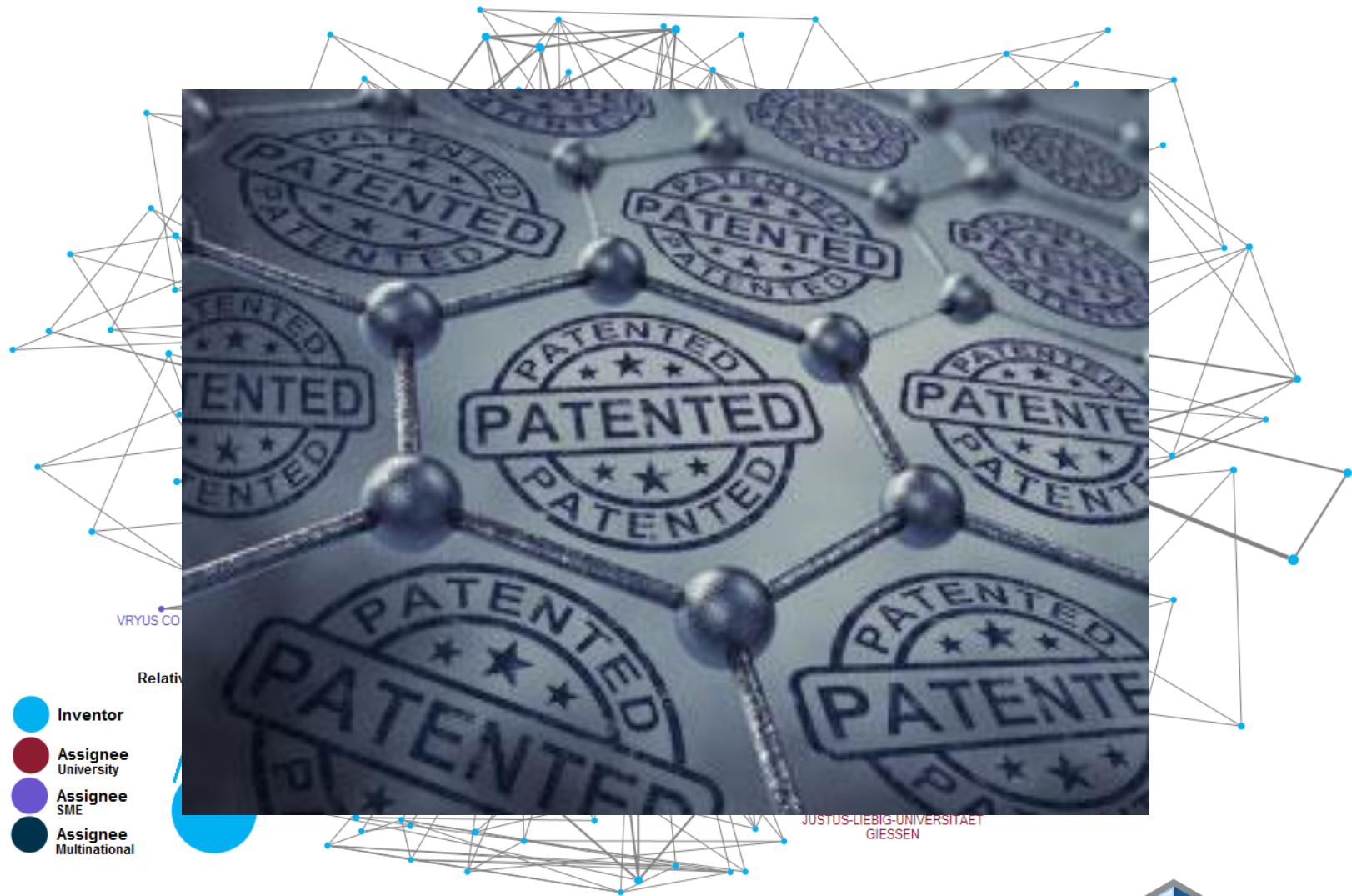




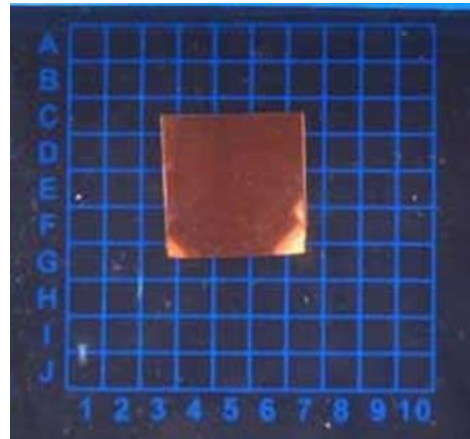


Challenge: Intellectual Property





Market: R&D Graphene Material



2012

2013

2014

2015



GRAPHENEA



Durham Graphene Science



BLUESTONE
GLOBAL TECH



GRAPHENEA

Small and Saturated



Durham Graphene Science

BLUESTONE
GLOBALTECH



2012

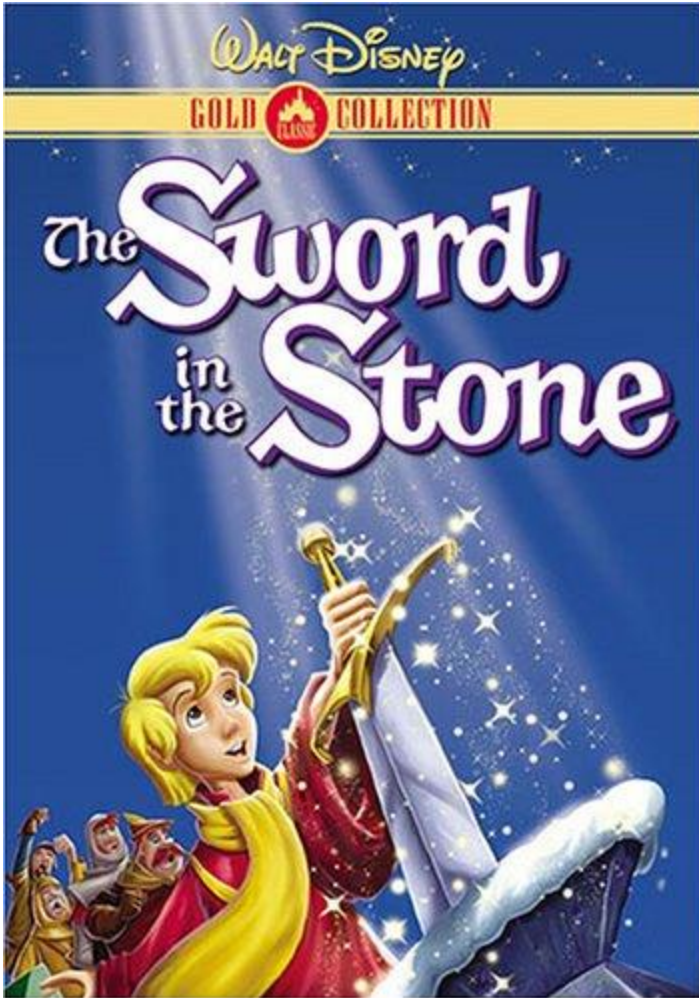
2013

2014

2015



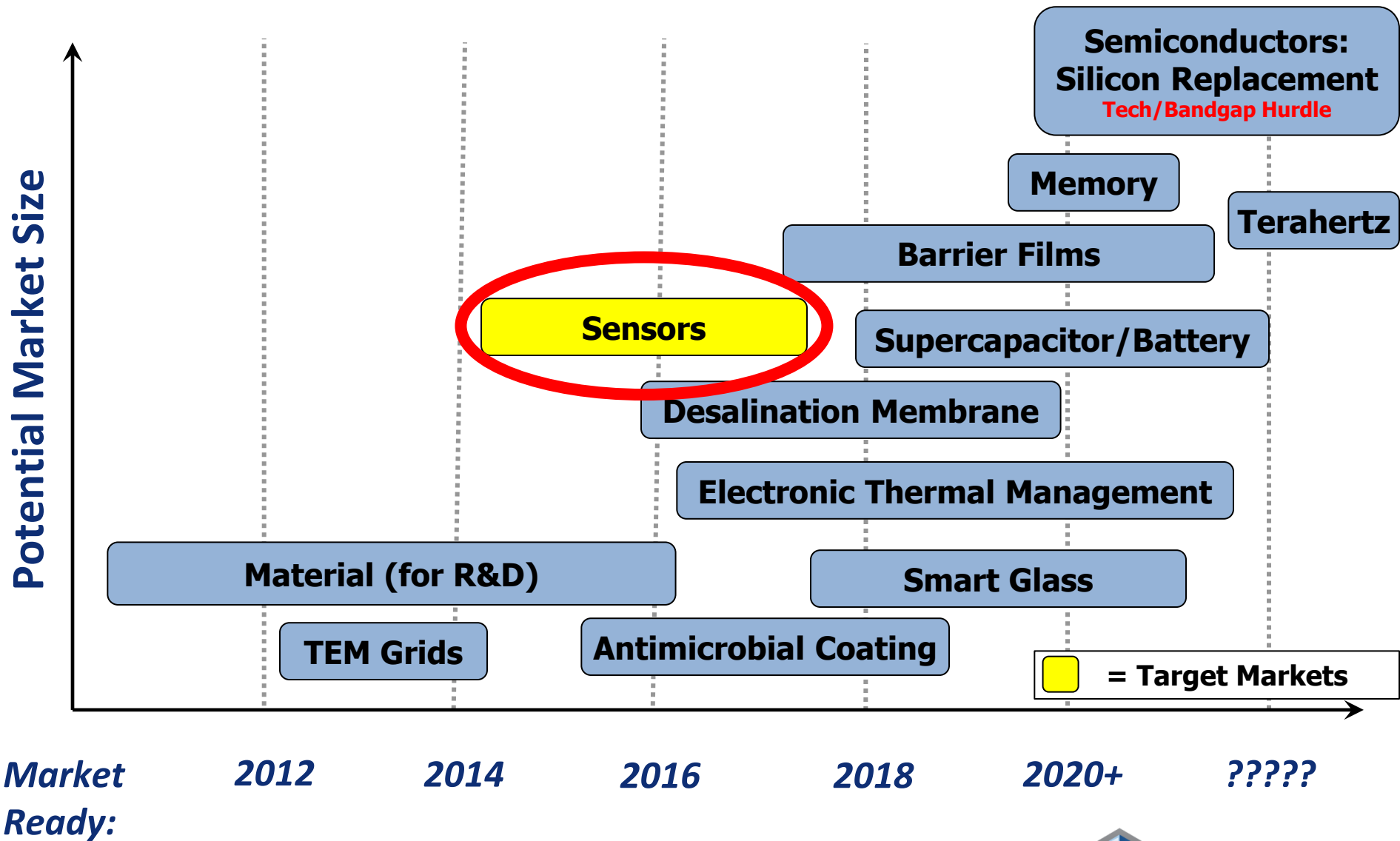
Chapter 3:



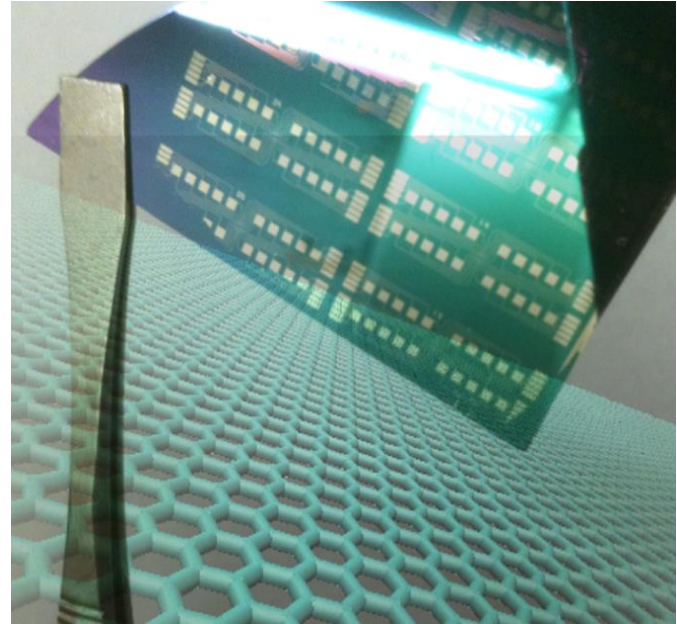
There is a solution:

Make something.

Markets: Size and Timing



Market: Bio/Chemical Sensors

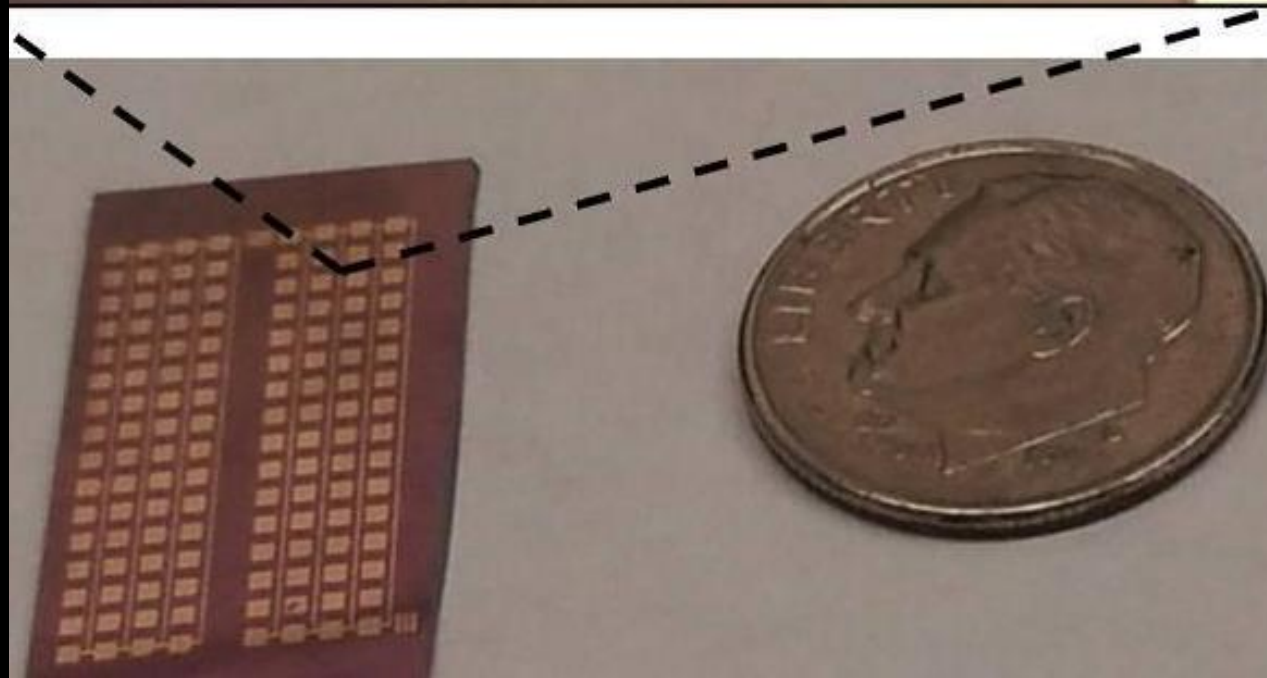
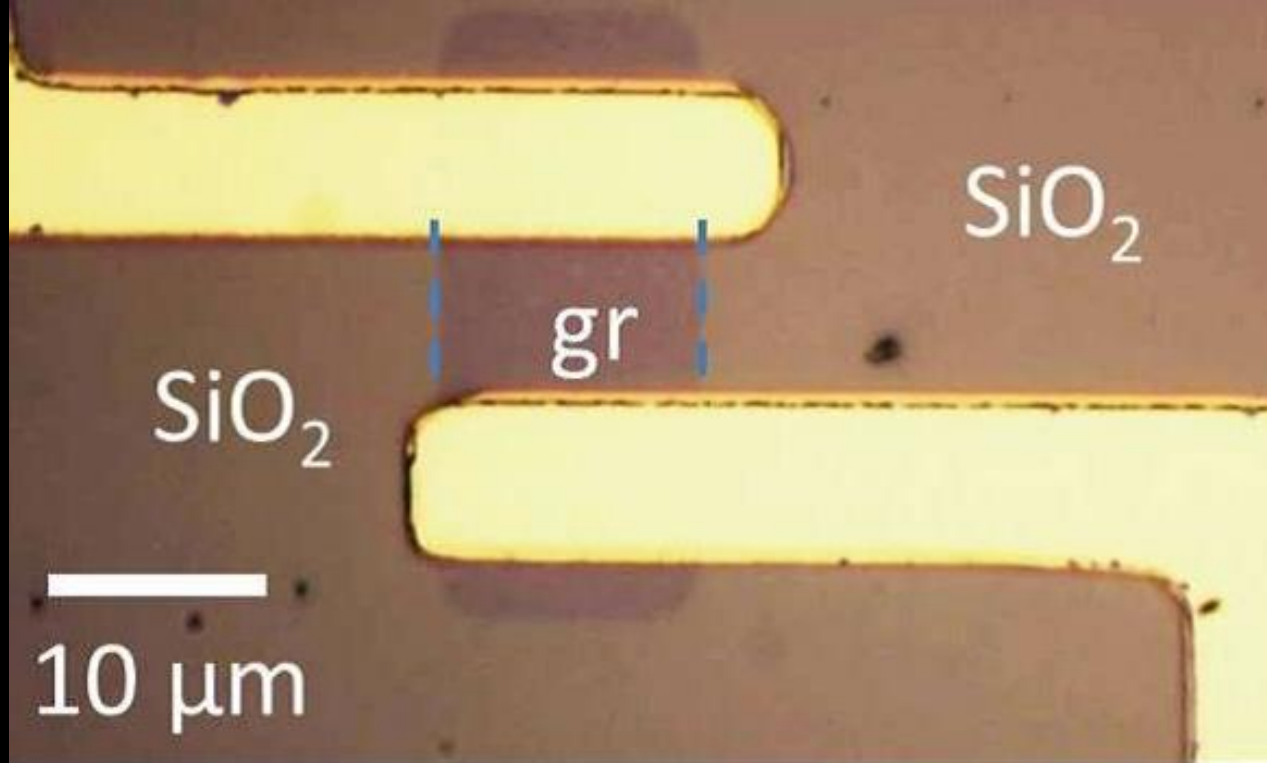


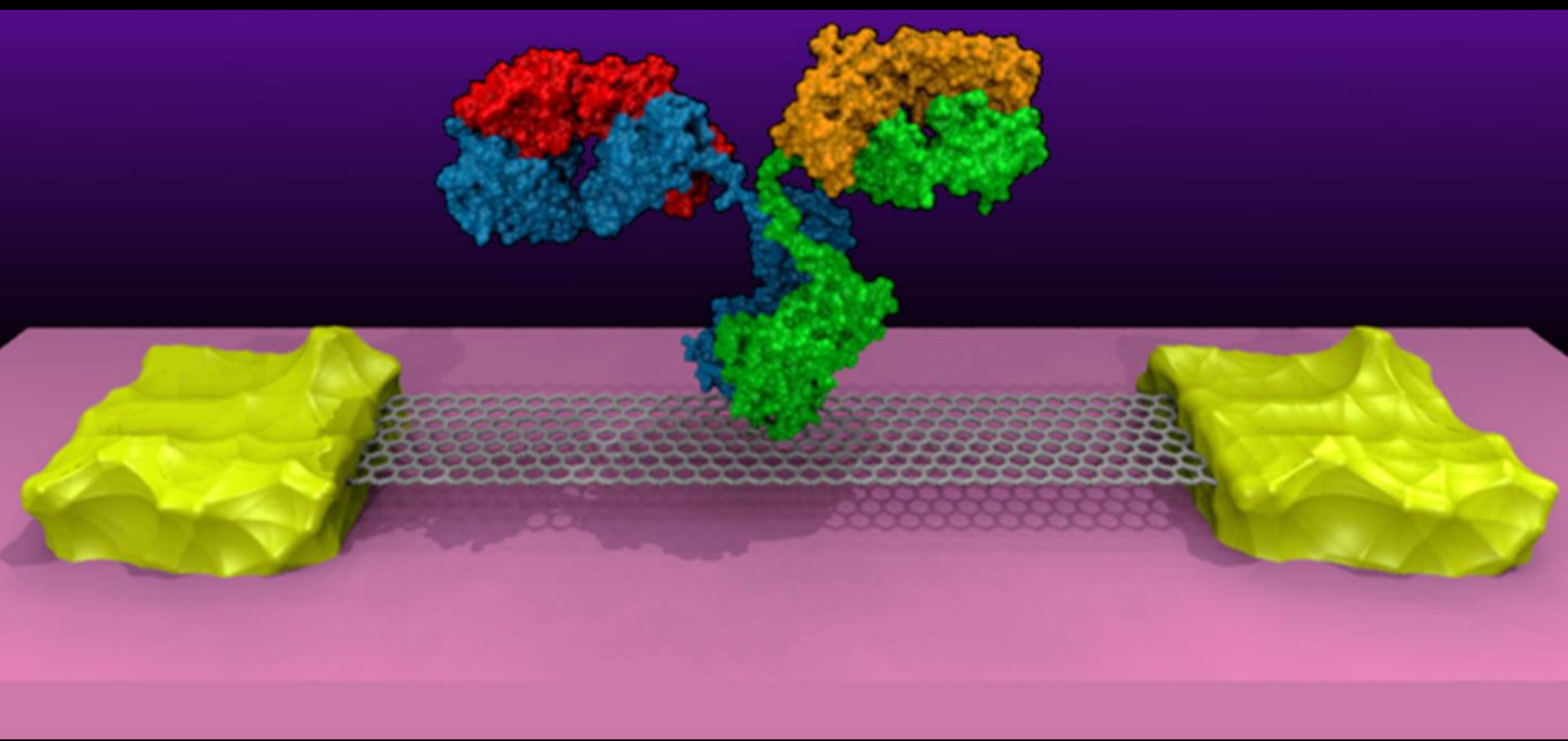
2012

2013

2014

2015





Team Graphene: **Founders**

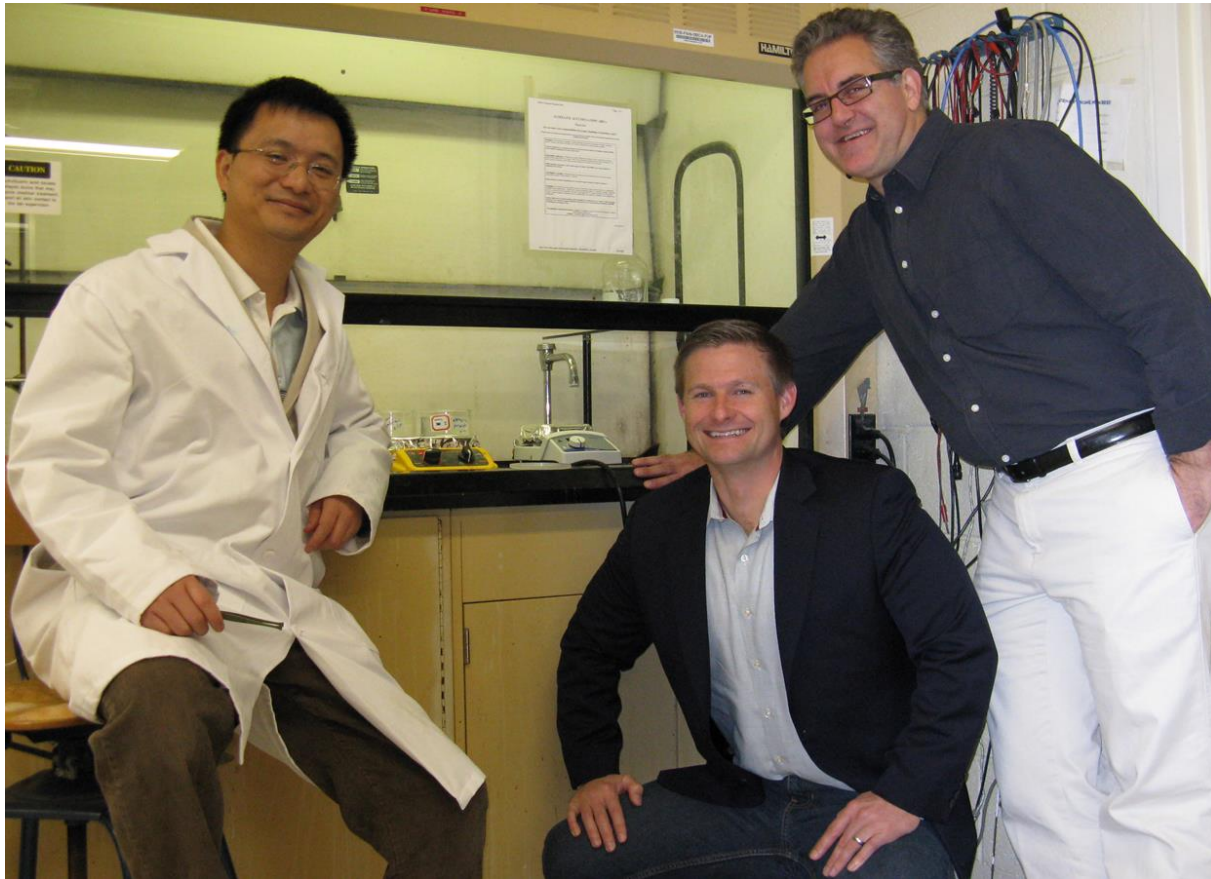
A.T. Charlie Johnson, Ph.D. – Founder, Advisor

- Professor, U. Penn; Harvard; Stanford; NSF, Packard, Sloan, APS Fellow
- Adamant Technologies, Sensor Expert, **21 Patents**

Zhengtang Luo, Ph.D. – Founder, Board Member

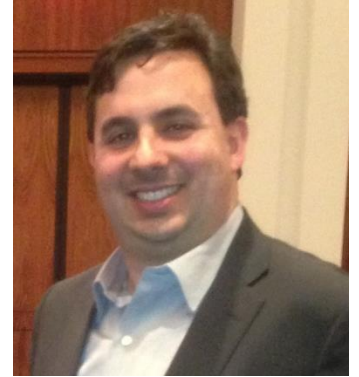
- Professor, HK-UST; U. Penn; U. Conn., Tech Transfer Fellow





CORPS
NSF Innovation Corps

Bruce Willner – Chief Science Officer



Cornell University



Mike Patterson – Chief Executive Officer



Certified Patent Valuation Analyst

Team Graphene – Product Team



Ryan Mendoza

- Electrical Engineering



Team Graphene – Product Team



Ryan Mendoza

- Electrical Engineering



Victoria Tsai, Ph.D.

- Neuroscience

- Clinical Research



Team Graphene – Product Team



Ryan Mendoza

- Electrical Engineering



Victoria Tsai, Ph.D.

- Neuroscience
- Clinical Research



Paige Boehmcke

- Materials Science



Support: Grants and Capital



WEMBA  Angels

The logo for WEMBA Angels features the word "WEMBA" in blue, followed by a stylized blue winged figure with a red "36" inside a white shield on its chest, and the word "Angels" in blue.



Graphene Frontiers

Mike Patterson - CEO

mike@graphenefrontiers.com

(267) 223-5051