MURIs and What They Lead To

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Impact? Curiosity? (Hits on Google, MM)

• Self-assembled monolayers 1.6
• Microcontact printing 0.24
• Soft lithography 0.22
  – Dip Pen Nanolithography 0.54
  – Imprint Nanolithography 0.44
• Microfluidics 1.45
• Optofluidics 0.55
• Paper Diagnostics 22.
  – Diagnostics for All 77.
• Soft Robotics (9.8)
Self-Assembled Monolayers
SAMs
Chemistry

"Bottom Up"

Photolithography

"Top Down"

SAMs

Proteins

Room-temperature quantum behavior

0.1

1

10

100 nm
Microcontact Printing
Abbott, Xia, Rogers, Aizenberg
20-μm Au lines
EM shielding
X100? Cost reduction
Soft Lithography
Exposure:
- Transparency used as photomask
  - Negative photoresist on Si wafer

Development:
- Cast PDMS prepolymer

Curing:
- Cured PDMS with embossed structure
  - Photolithographically defined relief in photoresist

Ink PDMS with Alkanethiolates

Drill Reservoirs:
- Plasma Oxidize
  - Seal to flat surface

Buffer Reservoirs:
- Gold, copper, silver, palladium, etc

Sample Injection Reservoirs:
- PDMS, glass, etc
Flash Memory Device Layer

SFIL: Grant Willson

Limits? < 0.5 nm
Electronic Eyeball Camera via Stretchable Electronics

Epidermal Electronics

Skin Mounted, Deformed

Free Standing


John Rogers
Microfluidics
A diffusive splitter

direction of liquid flow

direction of photons

Output

[Graph showing intensity vs. distance from center of channel (μm)]
Paper Diagnostics
Liver Function Tests

1. Prick finger
2. Gently squeeze device
3. Blood on filter
4. Plasma (with liver function tests)
Soft Robotics
\[ \Delta P = 0 \]

\[ \Delta P = + \]

- Compressed air inflates pneumatic network, inducing strain
- Differential strain induces curvature
Paper/Elastomer Actuator

Harvard University. Whitesides Group.
Paper/Elastomer Actuator

Harvard University. Whitesides Group.
Technology = Companies

- Diagnostics for All
- Nano Terra
- MC 10
- Semprius
- Cool Edge
- Liquidia
- NanoInk
- Surface Logix
- Claros
- Cellectricon
- Fluidigm
- Raindance
- Biacore (chips)
- Molecular Imprints
- Minerva
- GeneOhm
As we are doing it, it is taking 10-20 years to go from “idea” to “manufactured product”.
Curiosity, or Problem

Science

“Amorphous Technology”

Product Prototype

Manufacturing Prototype

Manufactured Product
Essential
MURI
DURIP
DARPA
Gates Foundation

Absent
NSF
NIH
DoE

New Participants
BASF
Reliance
Wyss
Wyss
CSIR (India)
SAM $\rightarrow$ Micro contact printing

Abbott, Xia, Rogers, Aizenberg
Kumar, Whitesides
*Appl. Phys. Lett.*
(1993) 63, 2002

Whitesides/Surface Logix Inc

Quake/Fluidigm Inc