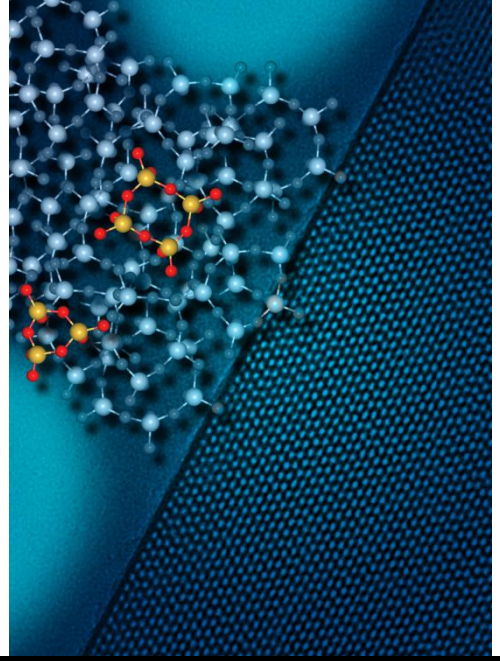
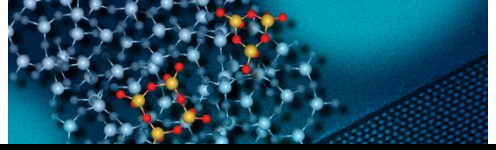


Nanoimprinting

Presented by MATEC NetWorks

NETWORKS



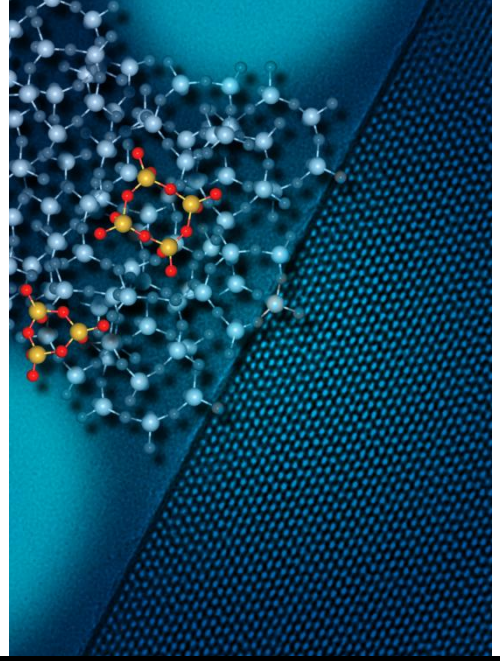
NETWORKS

MARICOPA COMMUNITY COLLEGES

NetWorks is a part of MATEC, a member of the Center for Workforce Development in the Division of Academic and Student Affairs.

National Science Foundation

Funded, in part, by a grant from the National Science Foundation.
DUE-0501626



Presenter

Ron Miller

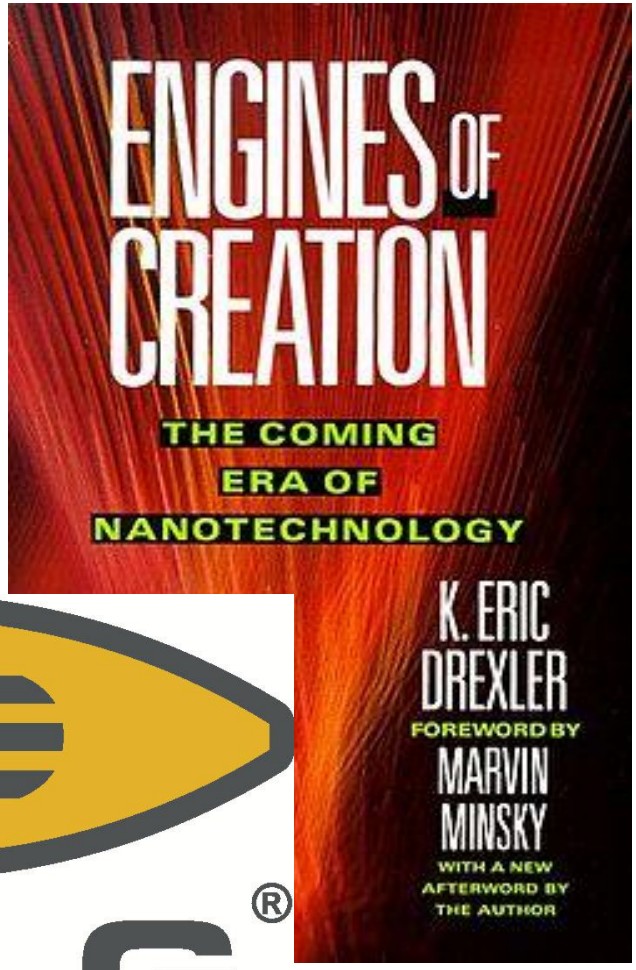
Nanoimprint Lithography Business Development Manager

r.miller@evgroup.com

EV Group, Inc.

My Background

- My name is: Ron Miller
- My company is: EV Group Inc
- My title is: Nanoimprint Lithography Business Development and External R&D Programs Manager
- My background is…

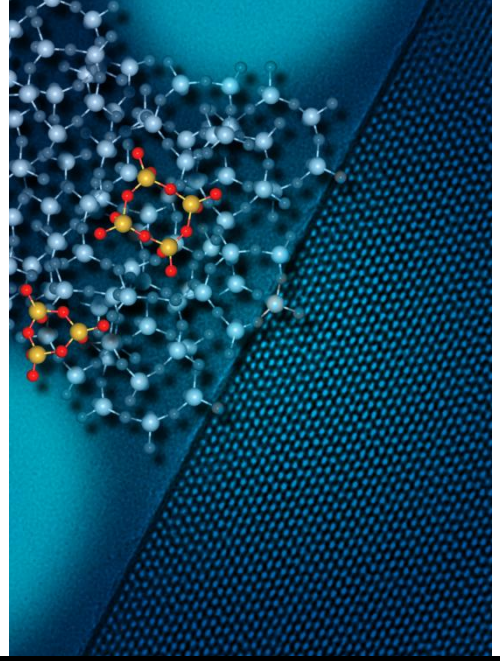


EVG®

ILLINOIS®
FIGHTING ILLINI

Objectives

- Nanoimprint Lithography (NIL) Overview
- NIL Equipment and Processes
- NIL Markets and Applications

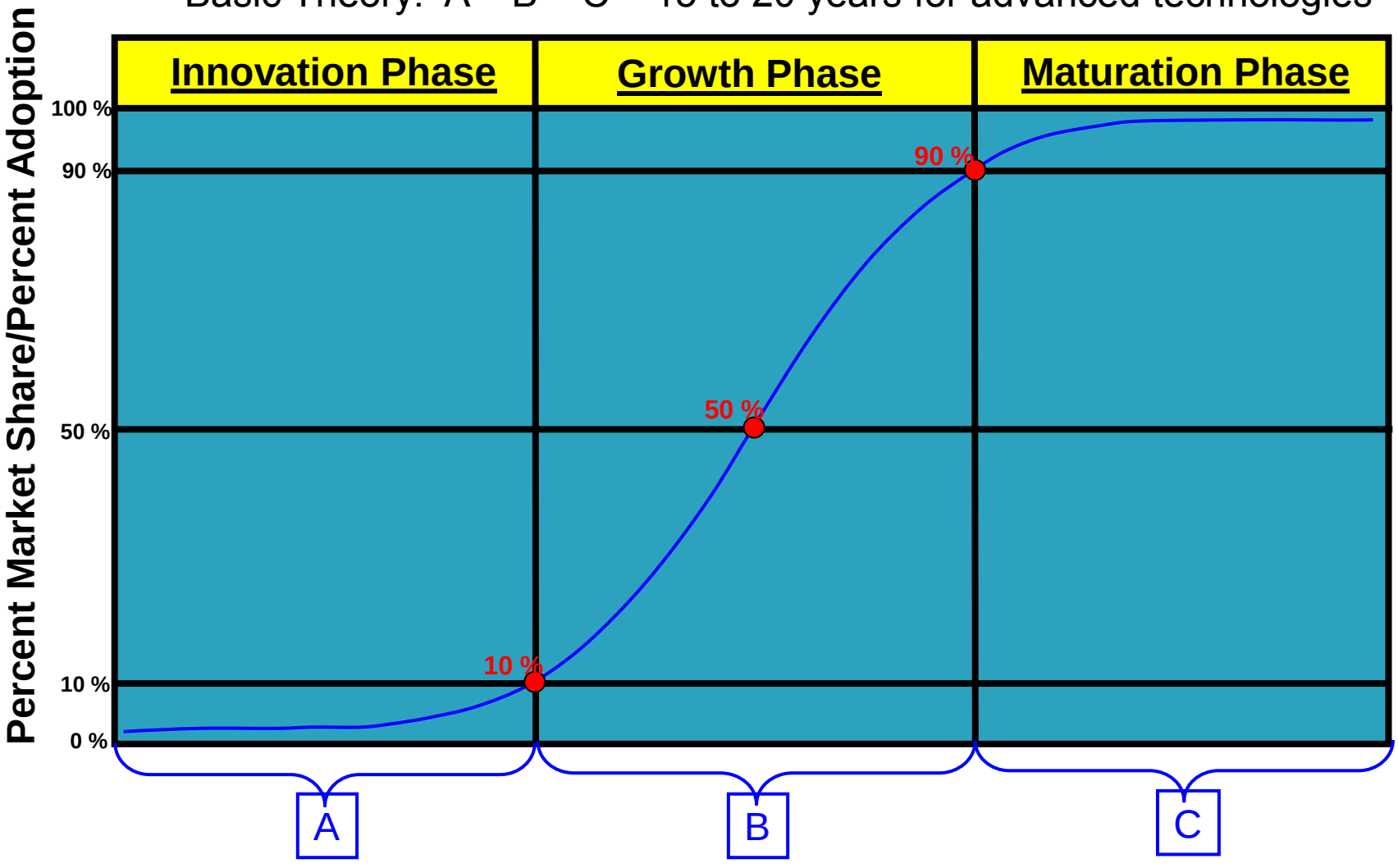


Nanoimprint Lithography:

Nanoimprint Lithography (NIL) Overview

Technology Adoption: S Curve Theory

Basic Theory: A ≈ B ≈ C ≈ 15 to 20 years for advanced technologies



NIL Timeline – Status of the Technology

NIL and EVG History:

1996: Dr. Stephen Chou's Seminal Paper on NIL

1997: EVG's first NIL System - µCP system to IBM

2000: EVG's first HE systems shipped

2007: Micro Imprint Litho into HVM with WLO

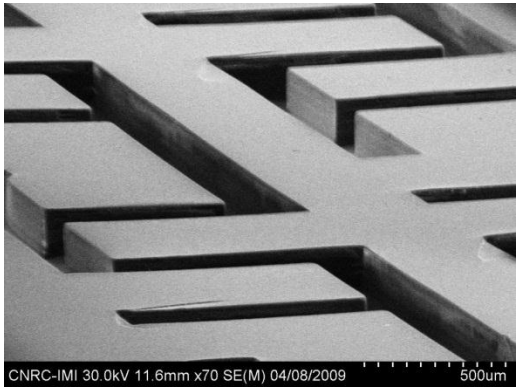
2011: > 400 Systems in the field (>150 for EVG)

2012: First true "Nano" systems ship for HVM

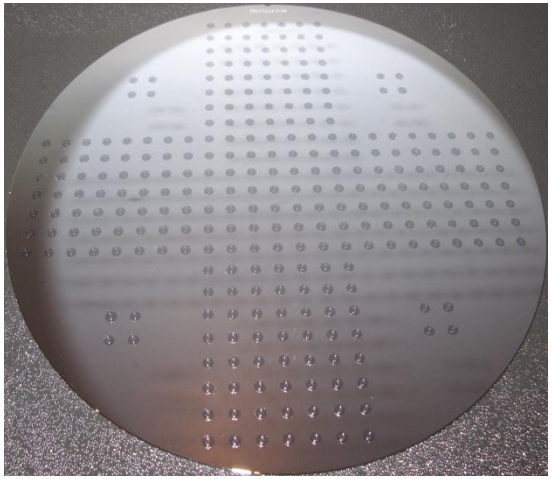
What is Nanoimprint Lithography???

Simple, fast, cost-effective method of patterning on the…..

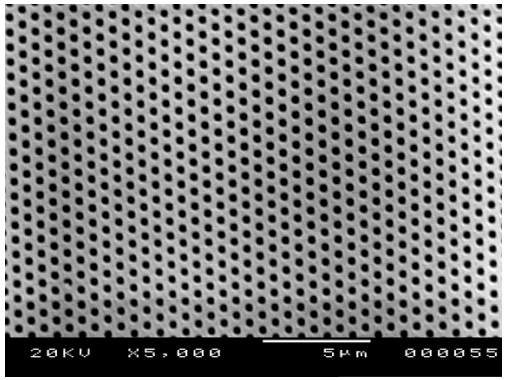
Micro….



Macro…

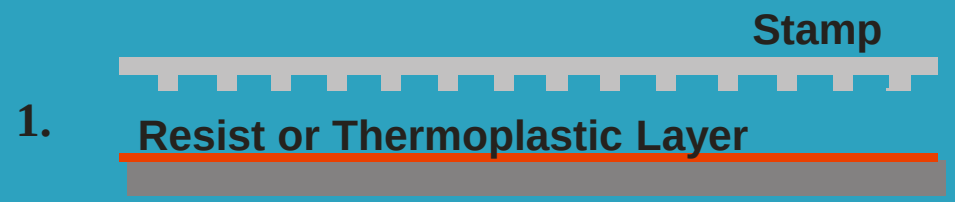


…and, of course, Nano-scale!



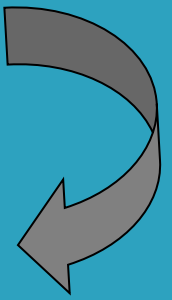
What is Nanoimprint Lithography???

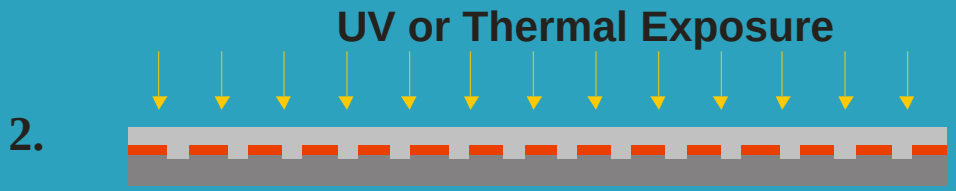
The basics…



Begin with a stamp and a substrate

Stamp and Target Substrate are brought into contact



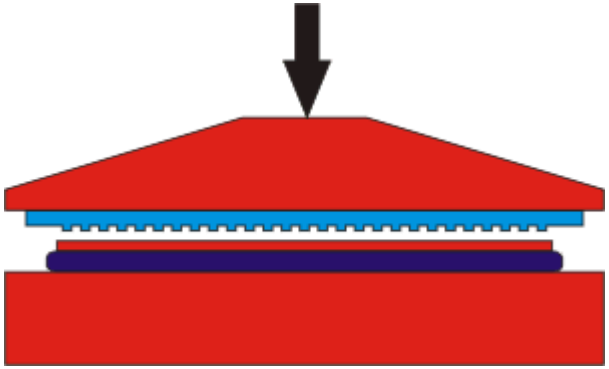


Stamp and Substrate separated

Inverse of Stamp features is left on target substrate

Approaches to NIL

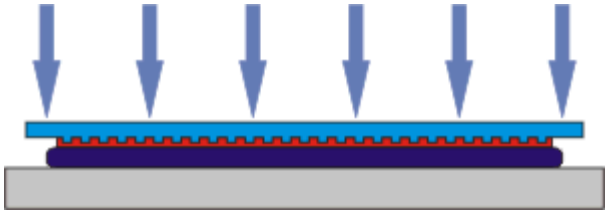
Hot Embossing (HE)



Temperature > Tg
Contact Force ~2-600kN
Vacuum

Achieved Resolution:
< 50nm

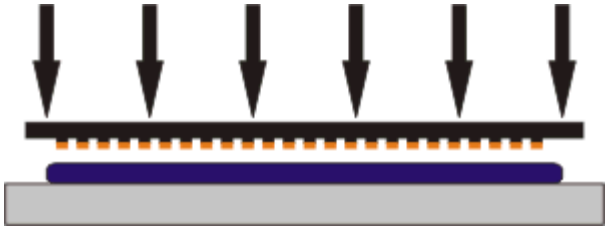
Nanoimprint Lithography (NIL)



Room Temperature
Contact Force ~ 1-150N
UV Light (350-450nm)

Achieved Resolution:
< 10nm

Micro Contact Printing (µCP)



Room Temperature
Contact Force ~1-40N
“inked” stamp

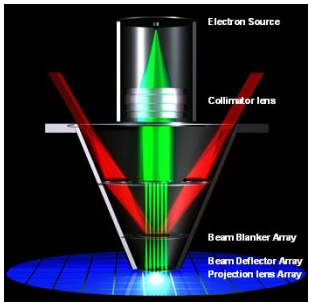
Achieved Resolution:
< 50nm

Alternative Patterning Technologies

Extreme UV

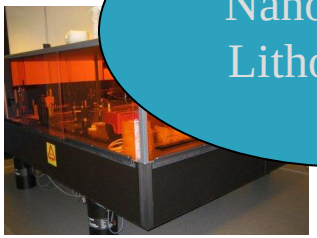
Immersion Lithography

Massively Parrallel
e-Beam Lithography



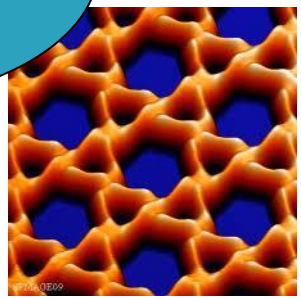
e-Beam Lithography

Interferenc

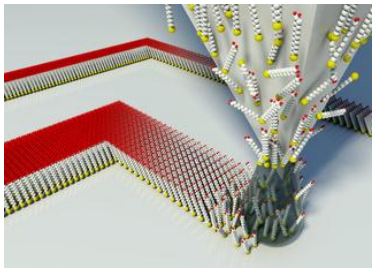


Nanoimprint
Lithography

Assembly



Dip Pen
Nanolithography



Cost

Throughput

NIL Companies

EVG®

TOSHIBA MACHINE

set
Smart Equipment Technology

NLS
NanoLithoSolution

SÜSS MicroTec

KIMM 한국기계연구원
KOREA INSTITUTE OF MACHINERY & MATERIALS

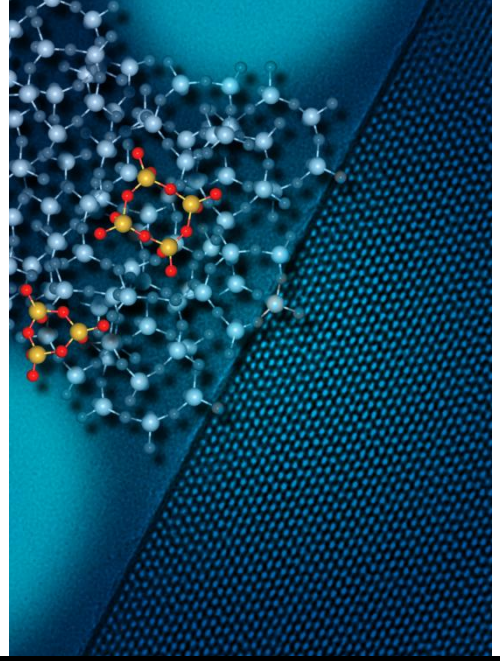
obducat®

Nanonex
Engine for Nanotechnology

DAI INSTRUMENTS

Molecular Imprints, Inc.

AML



Nanoimprint Lithography:

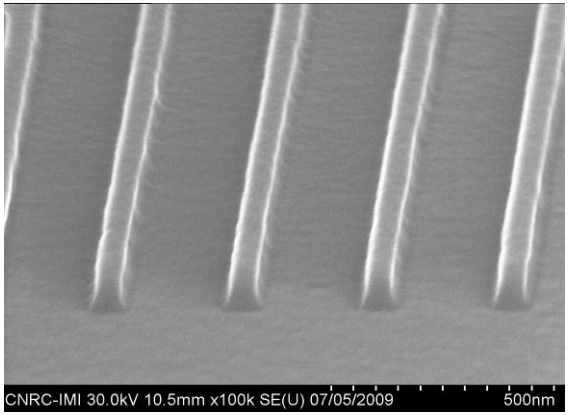
Equipment and Processes

Hot Embossing

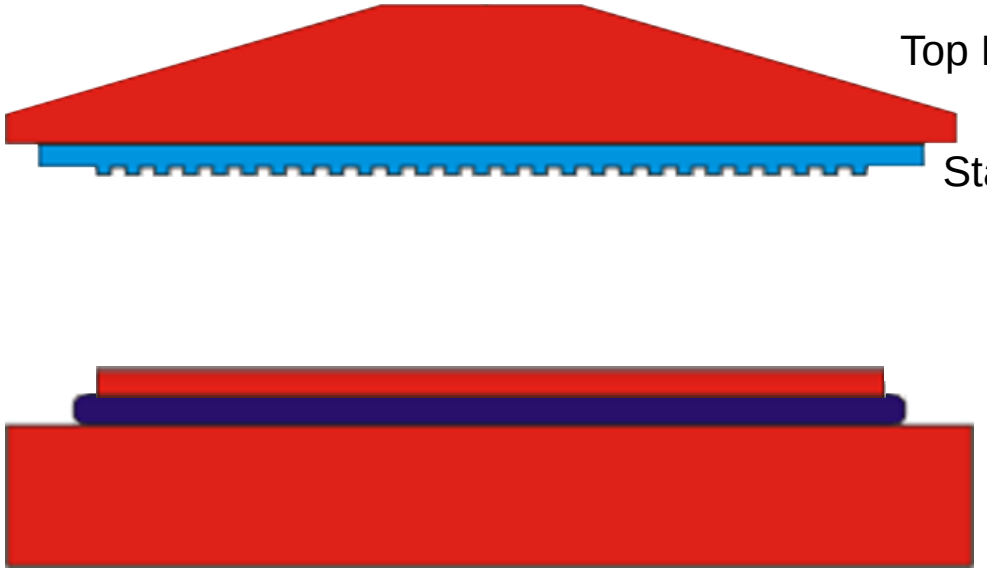
Hot Embossing

Temperature > Tg
Contact Force ~2-100kN
Vacuum

Achieved Resolution:
<50 nm
EVG520HE
Substrates: 50 – 200mm



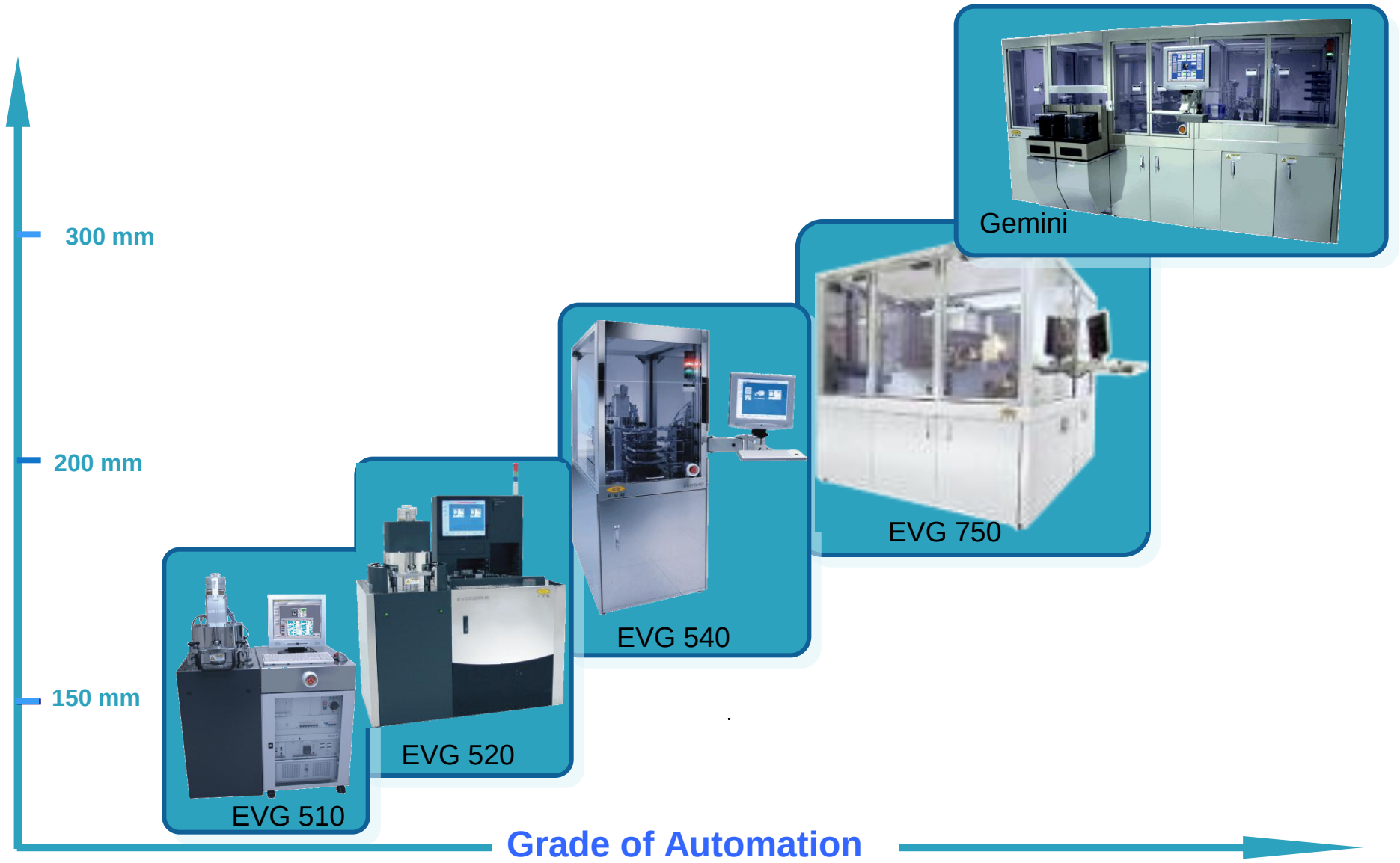
Process Flow



Wafer with spin on polymer or bulk polymer

Imprint of 50 nm gratings (Courtes of EVG)

Hot Embossing Systems at EVG



Hot Embossing Resolution

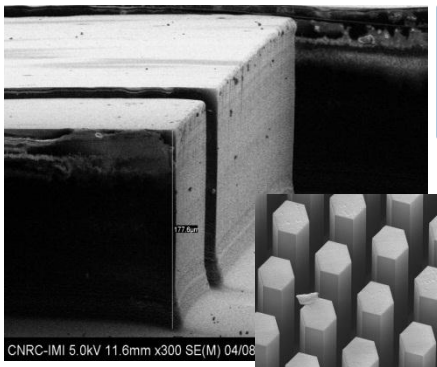
100 mm

30 mm

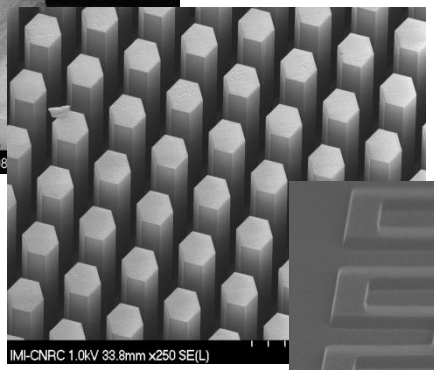
200 nm

80 nm

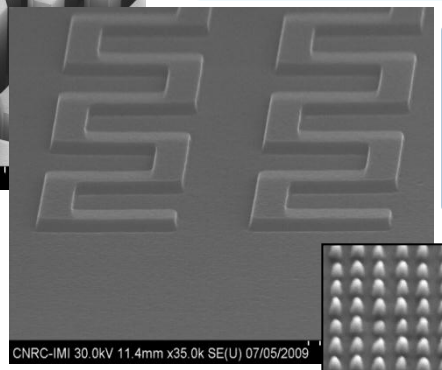
50 nm



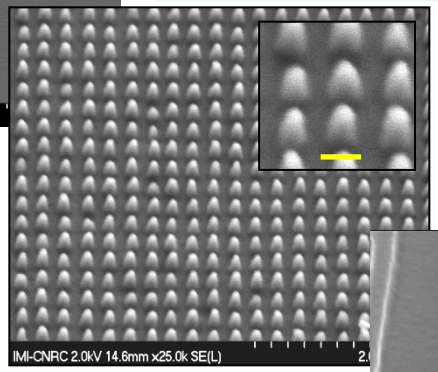
Micro Fluidic Channel (20 µm wide 180 µm deep)
(Courtesy of EVG)



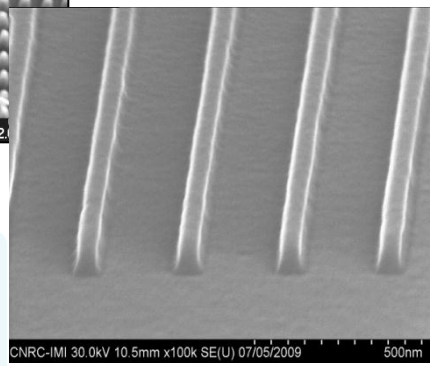
Plastic Microarrays (30 µm)
(Courtesy of IMI-NRC)



Soft Imprint Meander test structures
(200 nm)
(Courtesy of EVG)



Nanoarray (80 nm)
(Courtesy of IMI-NRC)



Soft Imprint L/S (50 nm)
(Courtesy of EVG)

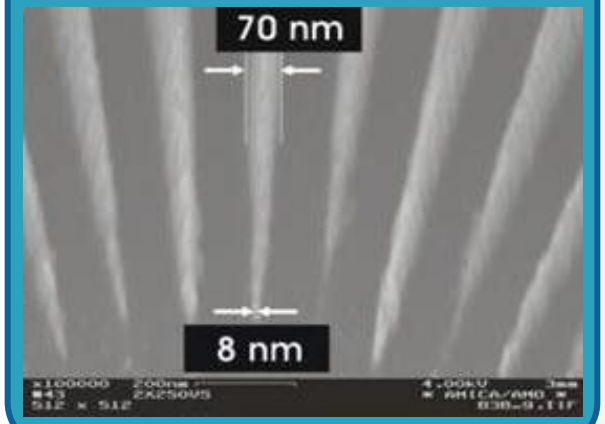
UV-NIL

UV-Nanoimprint Lithography

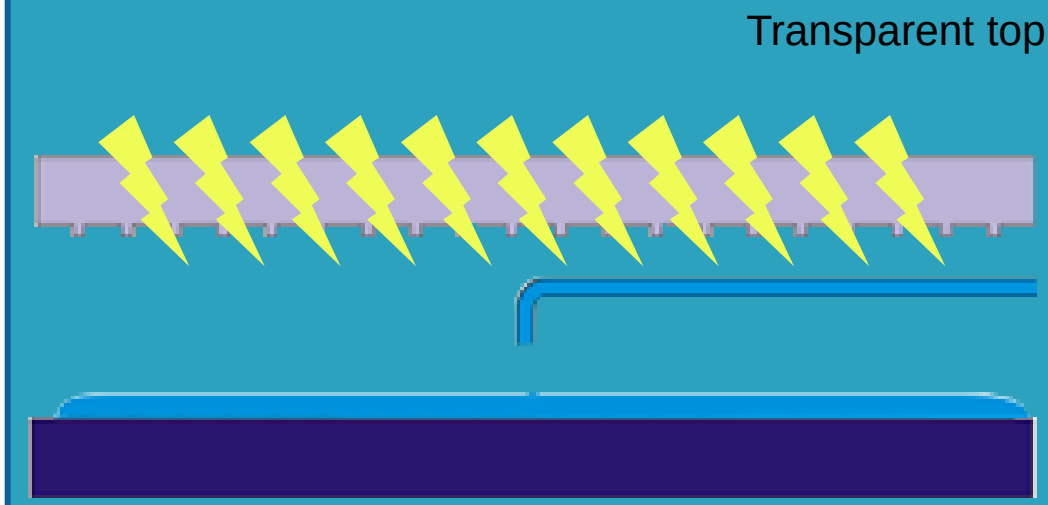
(UV-NIL)

Room Temperature
Contact Force ~ 1-100N
UV Light (350-450nm)

Achieved Resolution:
<10 nm
EVG620
Substrates: 10 – 150mm



Process Flow



Imprint high resolution features (Courtesy of AMO)

UV-NIL Systems at EVG

300 mm

200 mm

EVG 510

EVG620

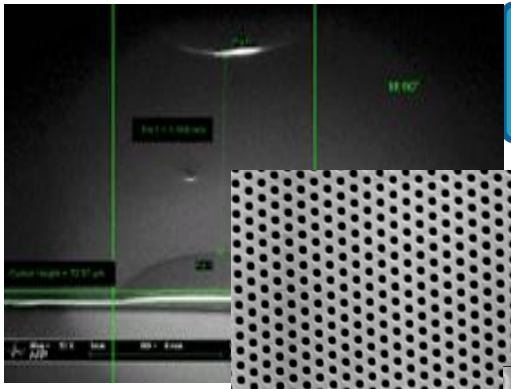
EVG 6200

IQ

EVG770

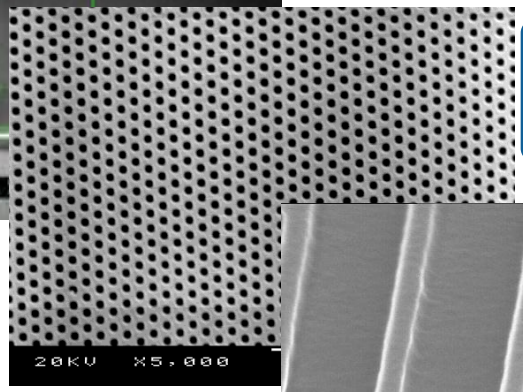
Grade of Automation

UV-NIL Resolution



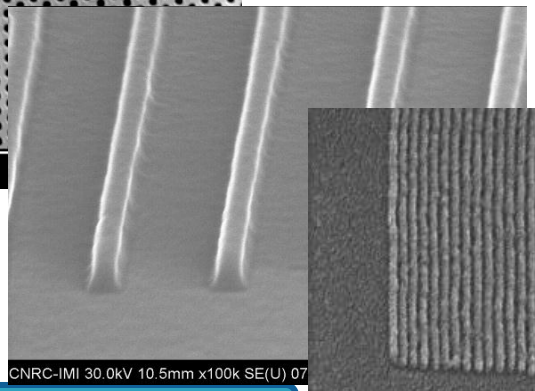
Micro Lens (several mm)
(Courtesy of EVG)

1000 mm



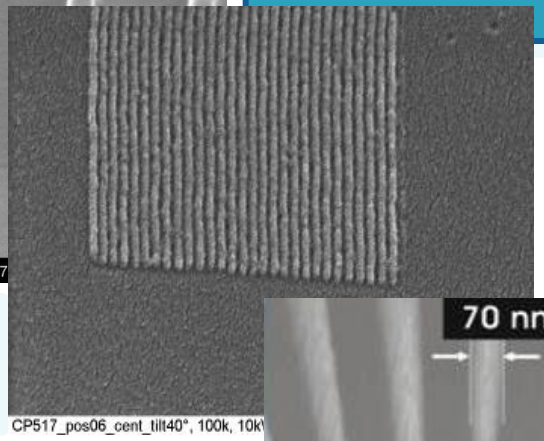
Photonic Crystal (350 nm)
(Courtesy of EVG)

100 nm



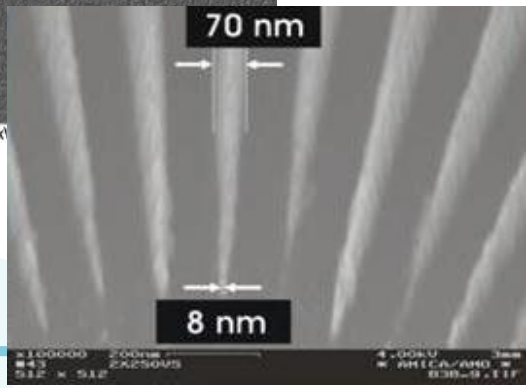
Test structure (50 nm)
(Courtesy of EVG)

50 nm



10 nm

Soft UV NIL (12.5 nm)
Courtesy of EVG Master fabricated by IMS



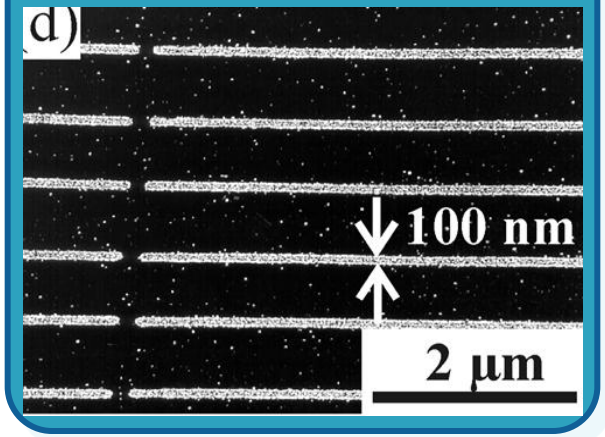
Siemens Star (8 nm)
(Courtesy of AMO)

micro-Contact Printing

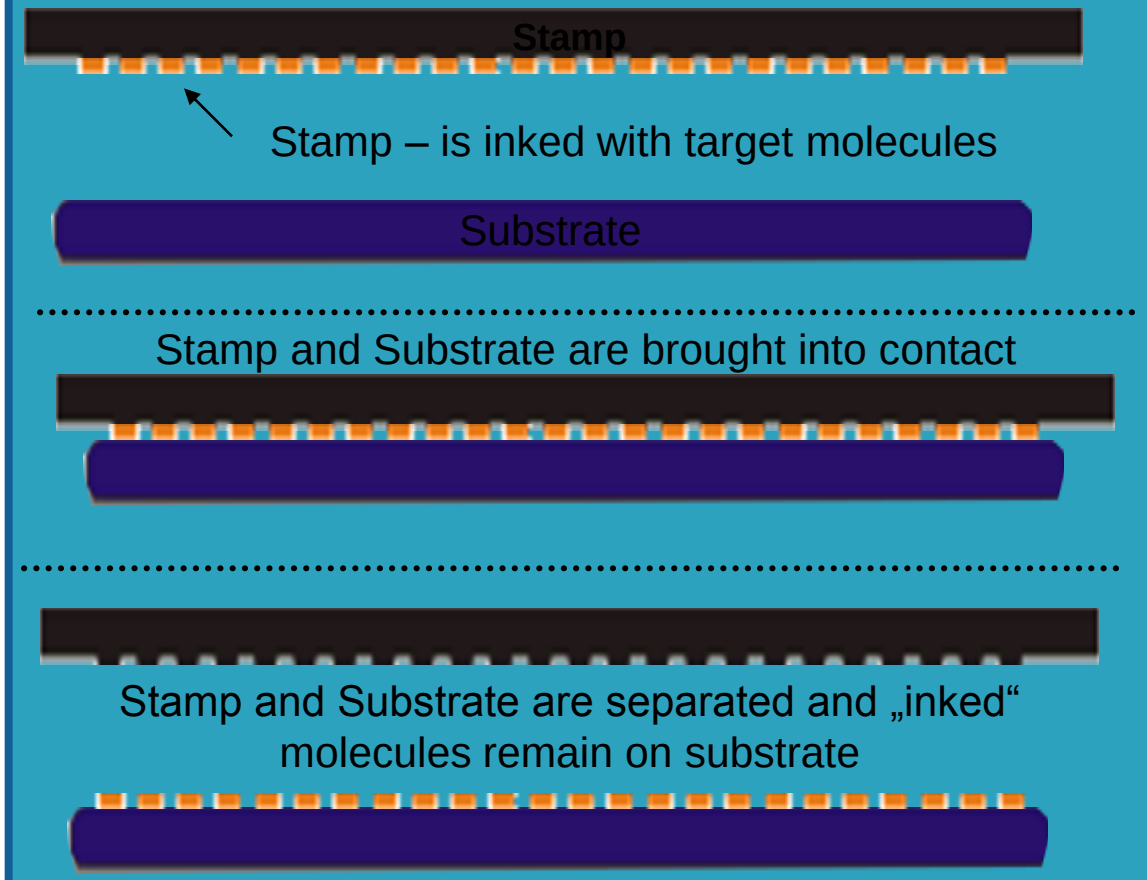
Micro Contact Printing (µCP)
Soft Lithography

Room Temperature
Contact Force ~1-40N
“inked” stamp

Achieved Resolution:
<50 nm
EVG620
Substrates: 10 – 150mm



Process Flow



Imprint of 100 nm gratings (Courtesy of IBM Rüschlikon)

µ-CP Systems at EVG

300 mm

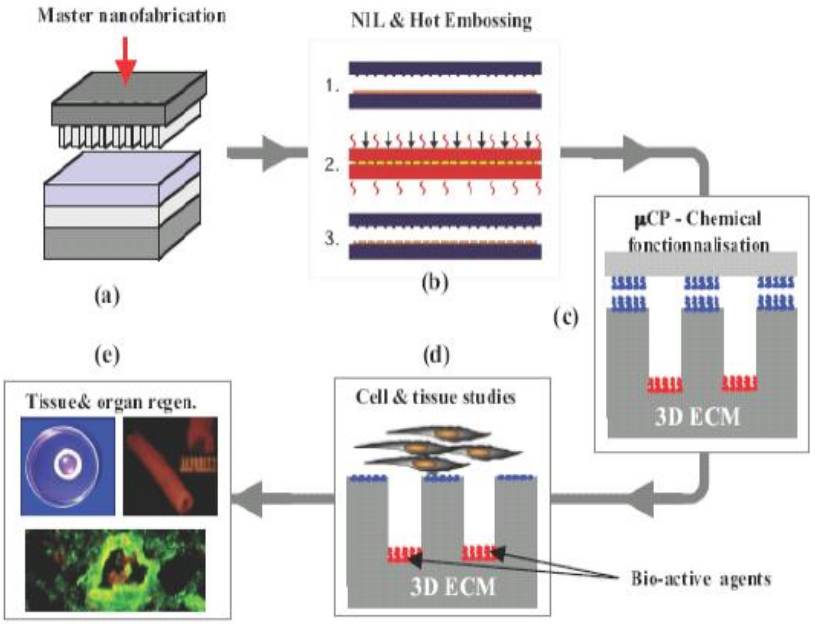
200 mm

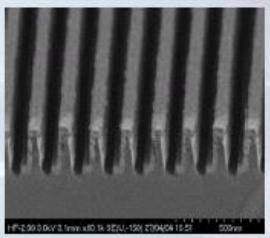
150 mm

Grade of Automation

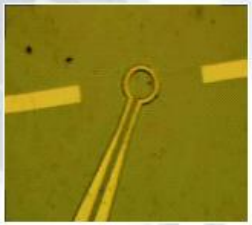
micro-Contact Printing Example

Life Science

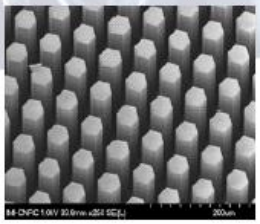


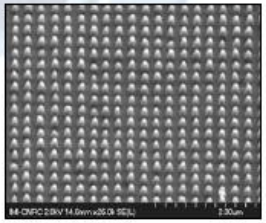


Metal (Au on Si) nano-patterns (IMI 2004)



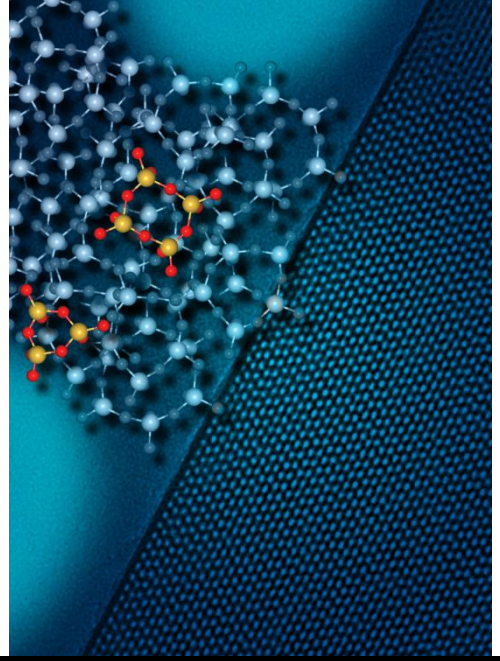
Metal (Au on Si) micro-electrodes (IMI 2003)





2D & 3D Biocompatible polymer micro - nano-patterns (IMI 2003 ,2004)

Courtesy of: CIHR-NRC Convergent Research Framework 2004

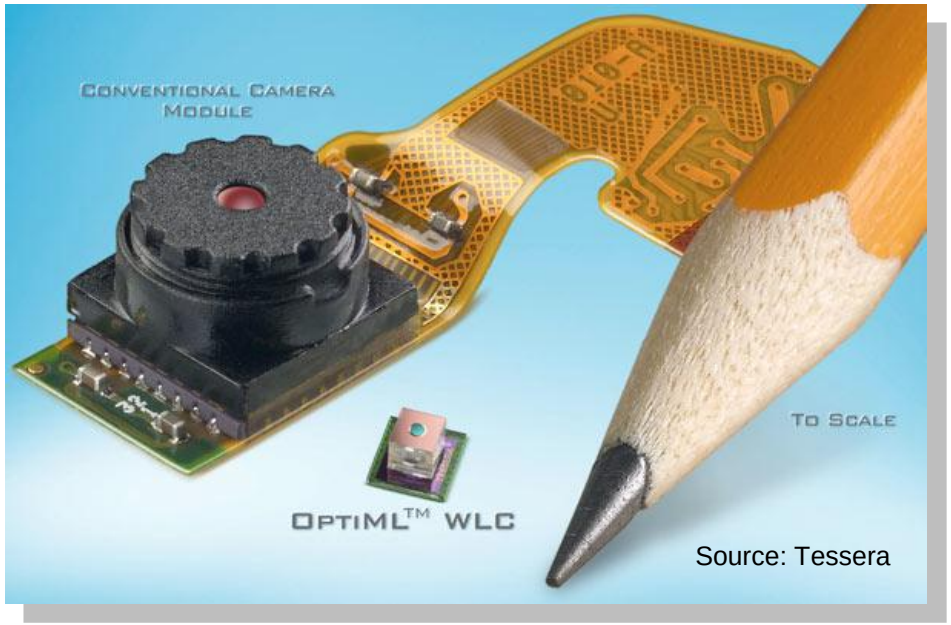


Nanoimprint Lithography:

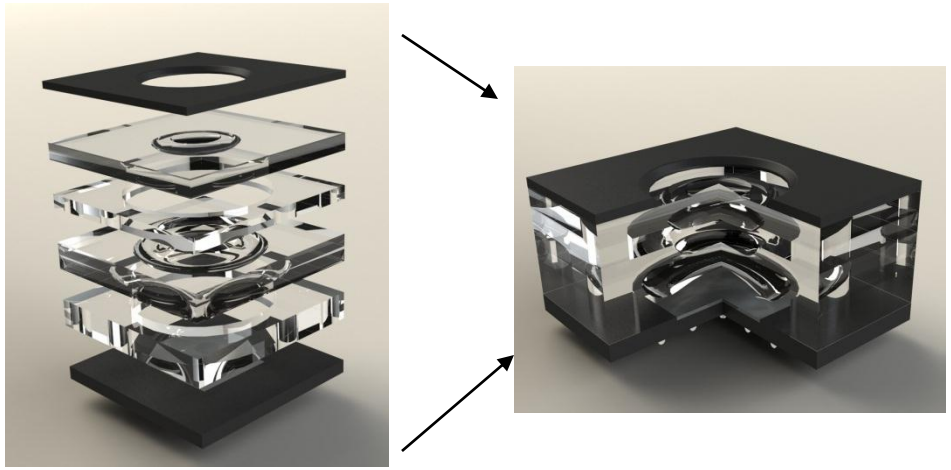
Markets and Applications

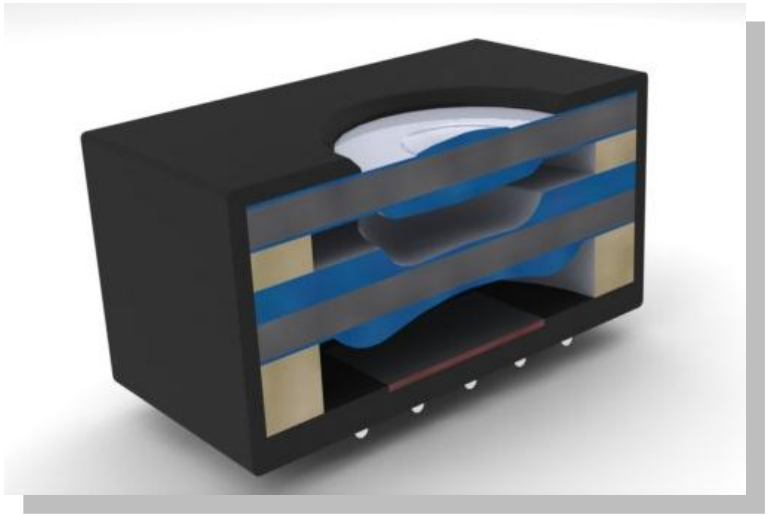
Wafer Level Camera/Optics (WLC/WLO)

Wafer Level Camera/Optics (WLC/WLO)



Source: Tessera

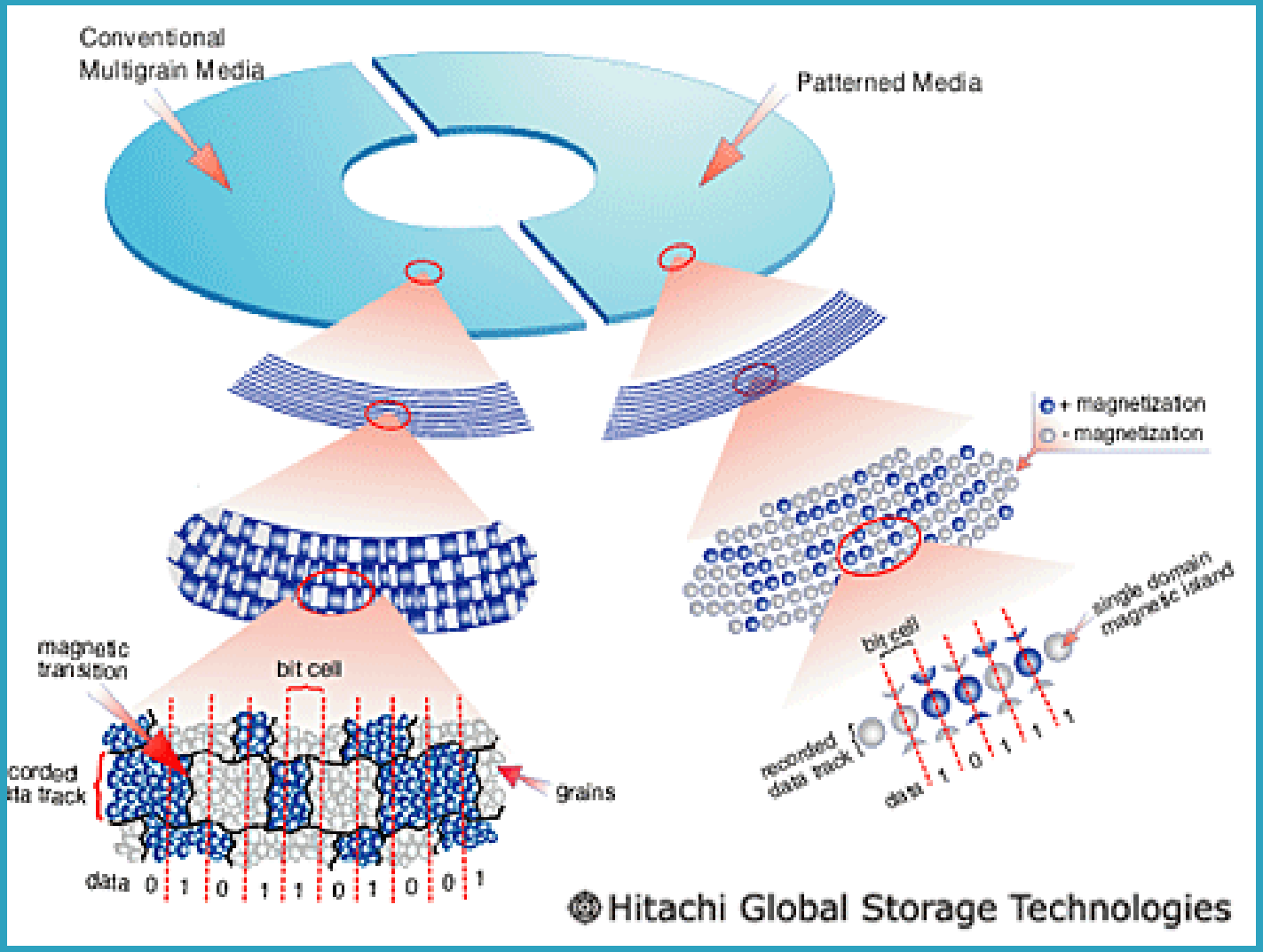




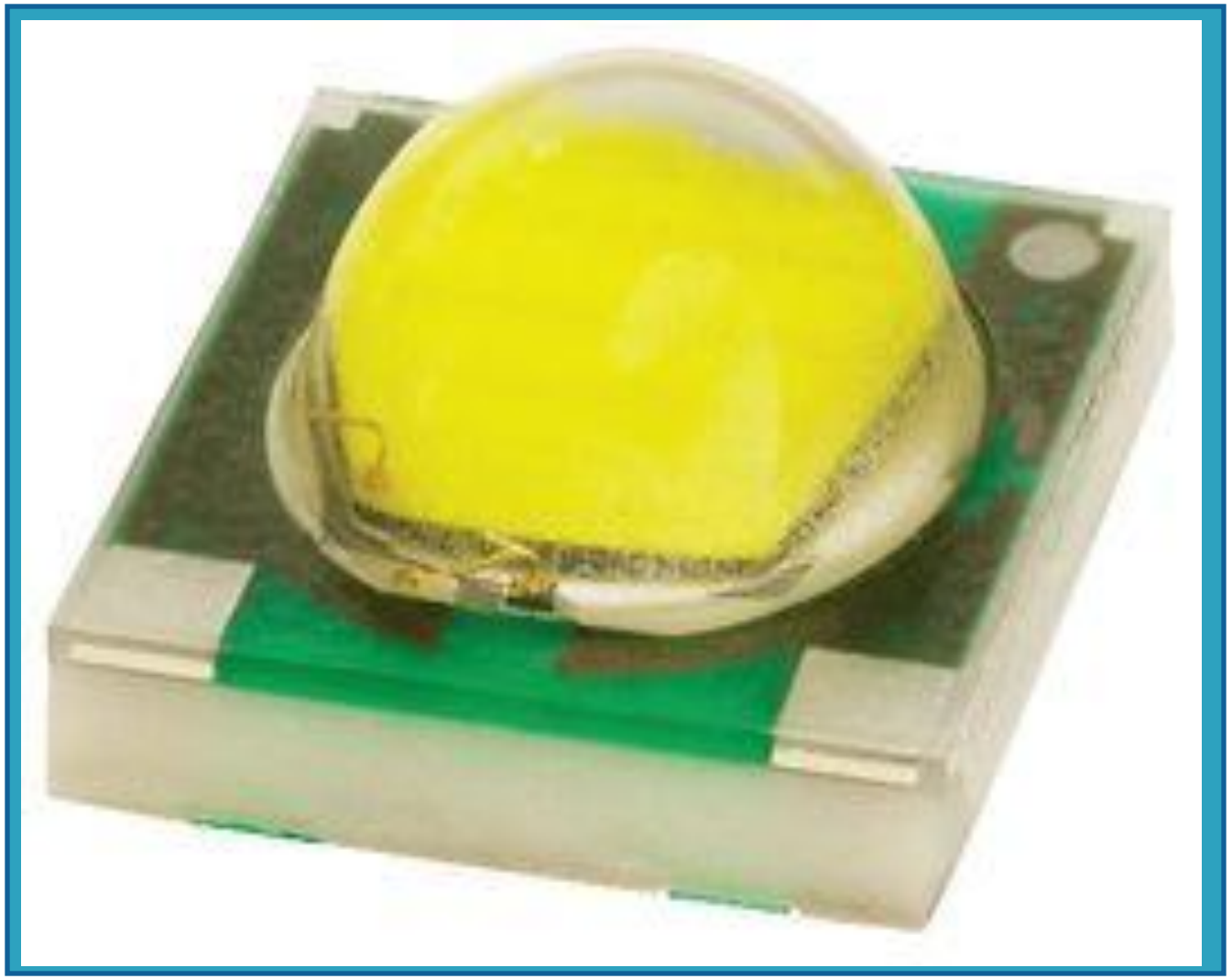
Data Storage

Data Storage

Bit Pattern Media (BPM) Technology



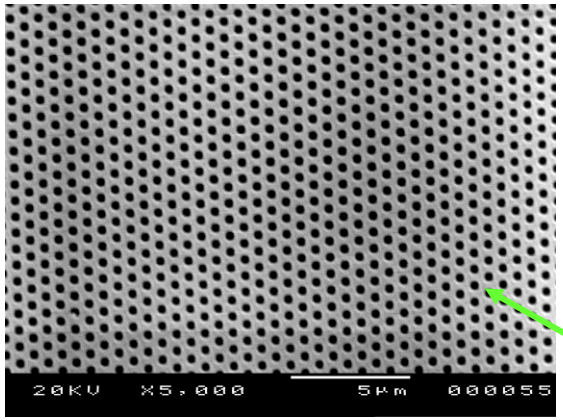
NIL Enables HB-LEDs

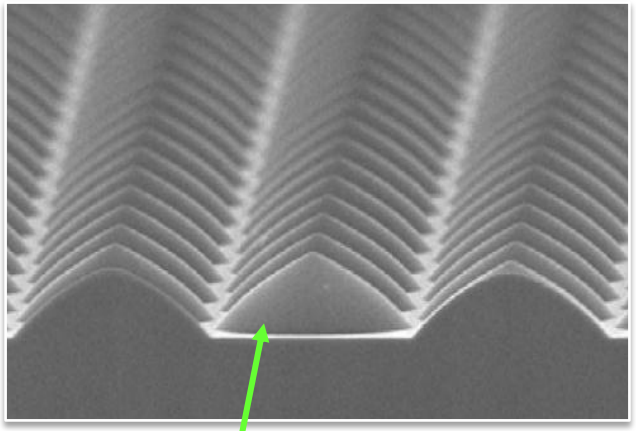


NIL Enables HB-LEDs

Quasi-Photonic Crystals

Patterned Sapphire Substrates





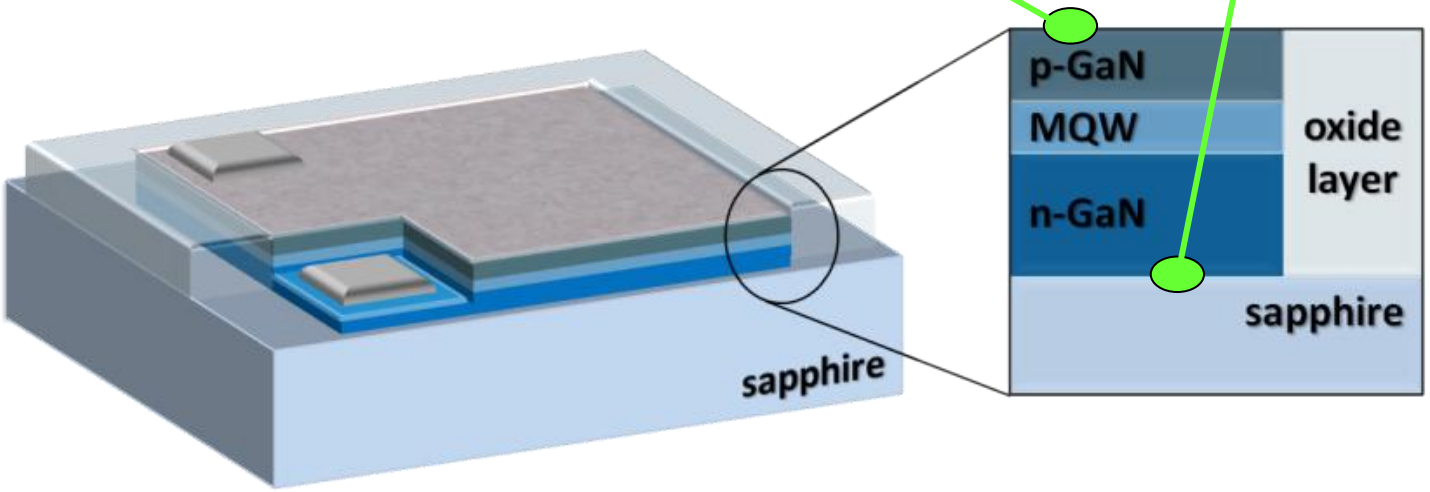


Photo Voltaic

Photo Voltaic

Conventional heterojunction solar cell

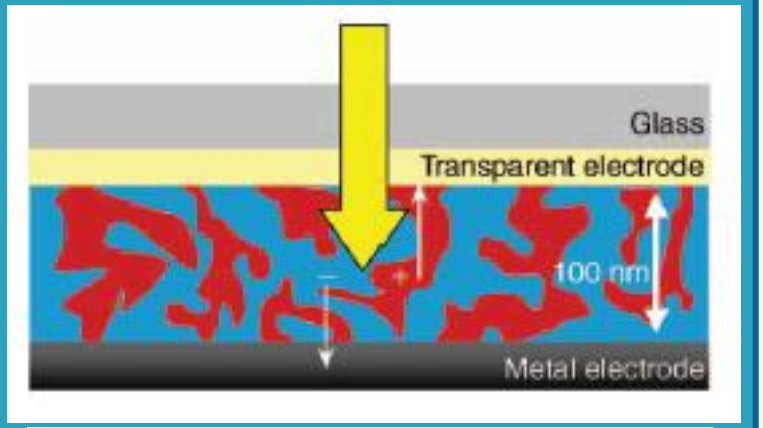
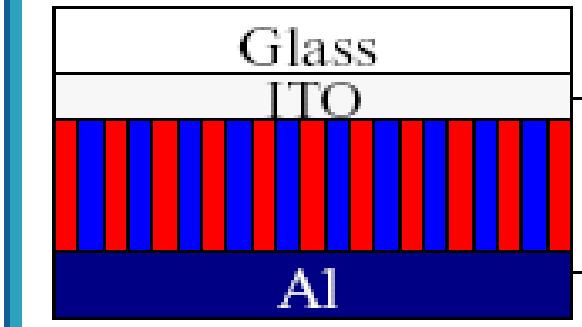
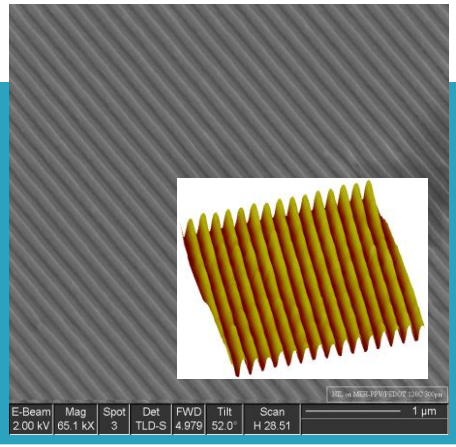
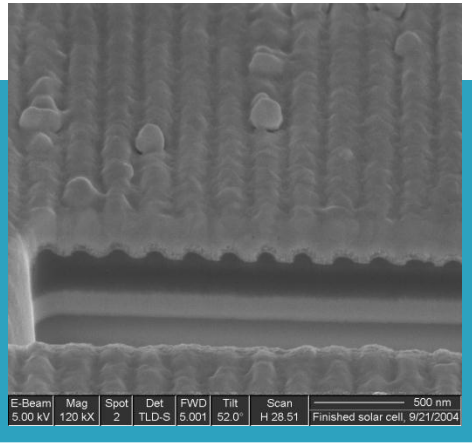


Figure: Schematic representation of a bulk heterojunction solar cell, showing the phase separation between donor (red) and acceptor (blue) materials.

Nanoimprinted heterojunction solar cell



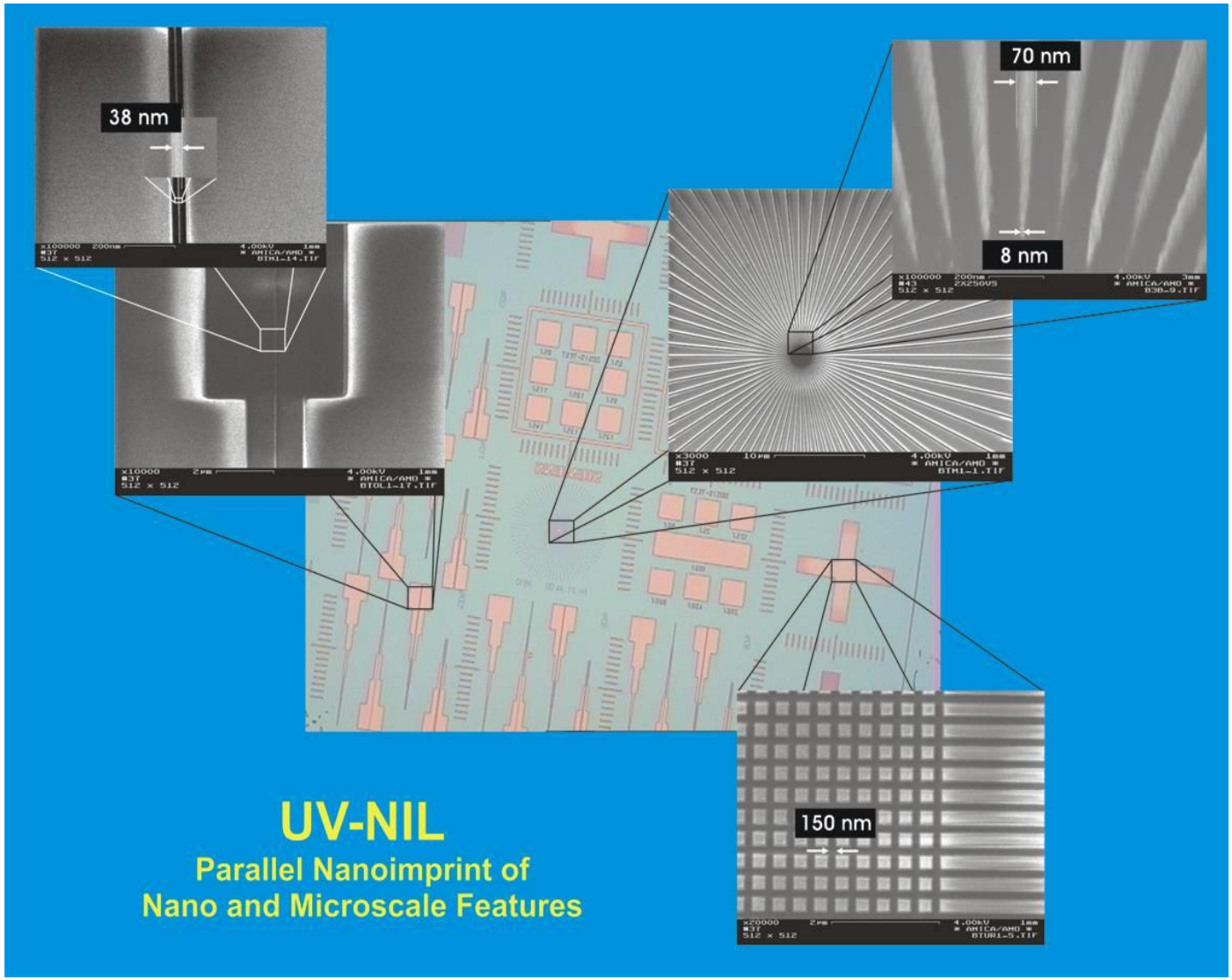




Finished device: Layers: Al/Alq3/MEH-PPV/PEDOT/ITO/glass
(Courtesy of IMI-NRC)

Nano Electronics

Nano Electronics

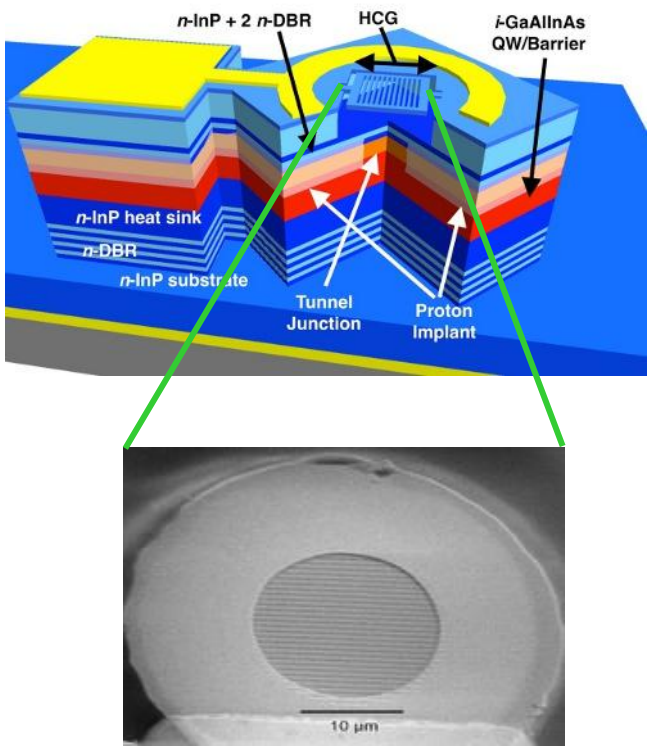


Imprint of micron sized features down to sub 10 nm using hard UV nano imprint lithography

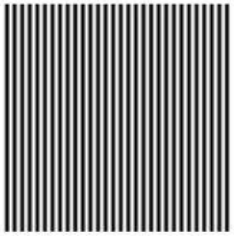
Courtesy AMICA – Advanced Microelectronic Center Aachen

Other Optics: Applications

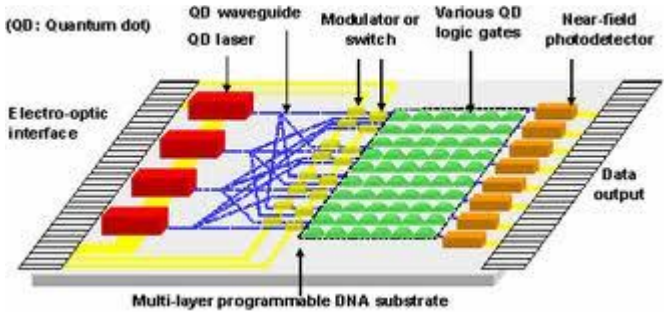
VCSEL Gratings



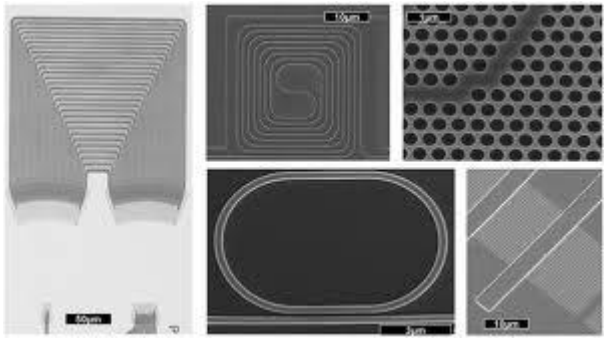
Gratings for Displays



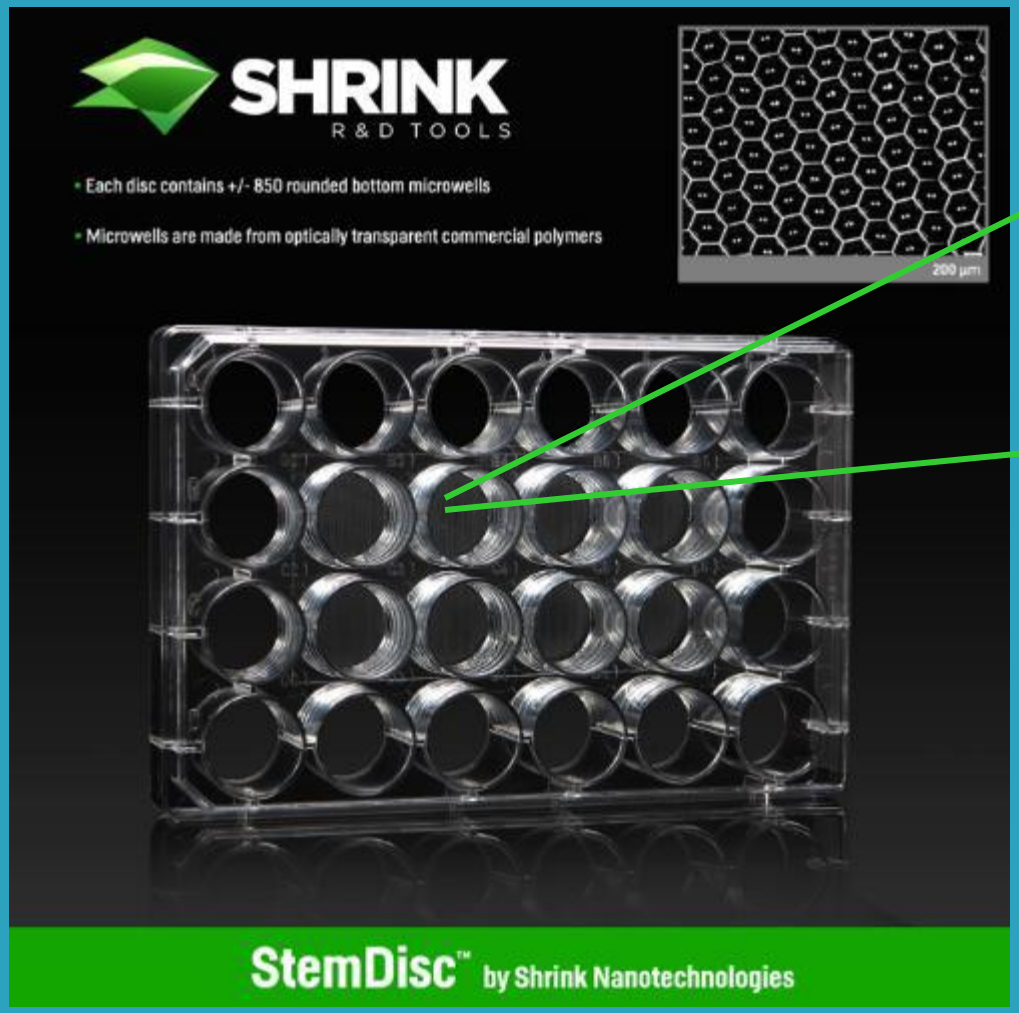
Photonic Integrated Circuits

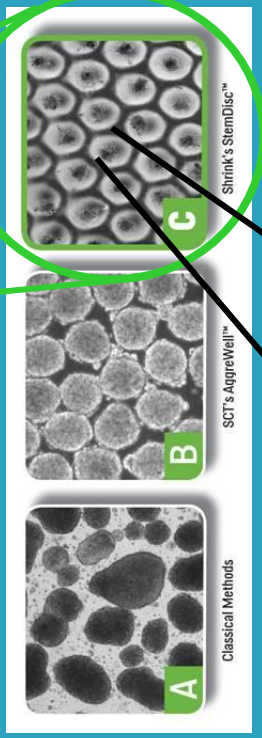


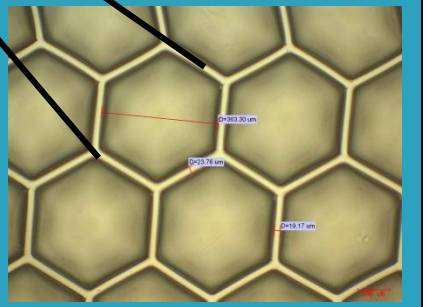
Passive Photonic Devices



Stem Cell Growth Devices







Lab on a Chip

Miniaturisation for chemistry, physics, biology, & bioengineering

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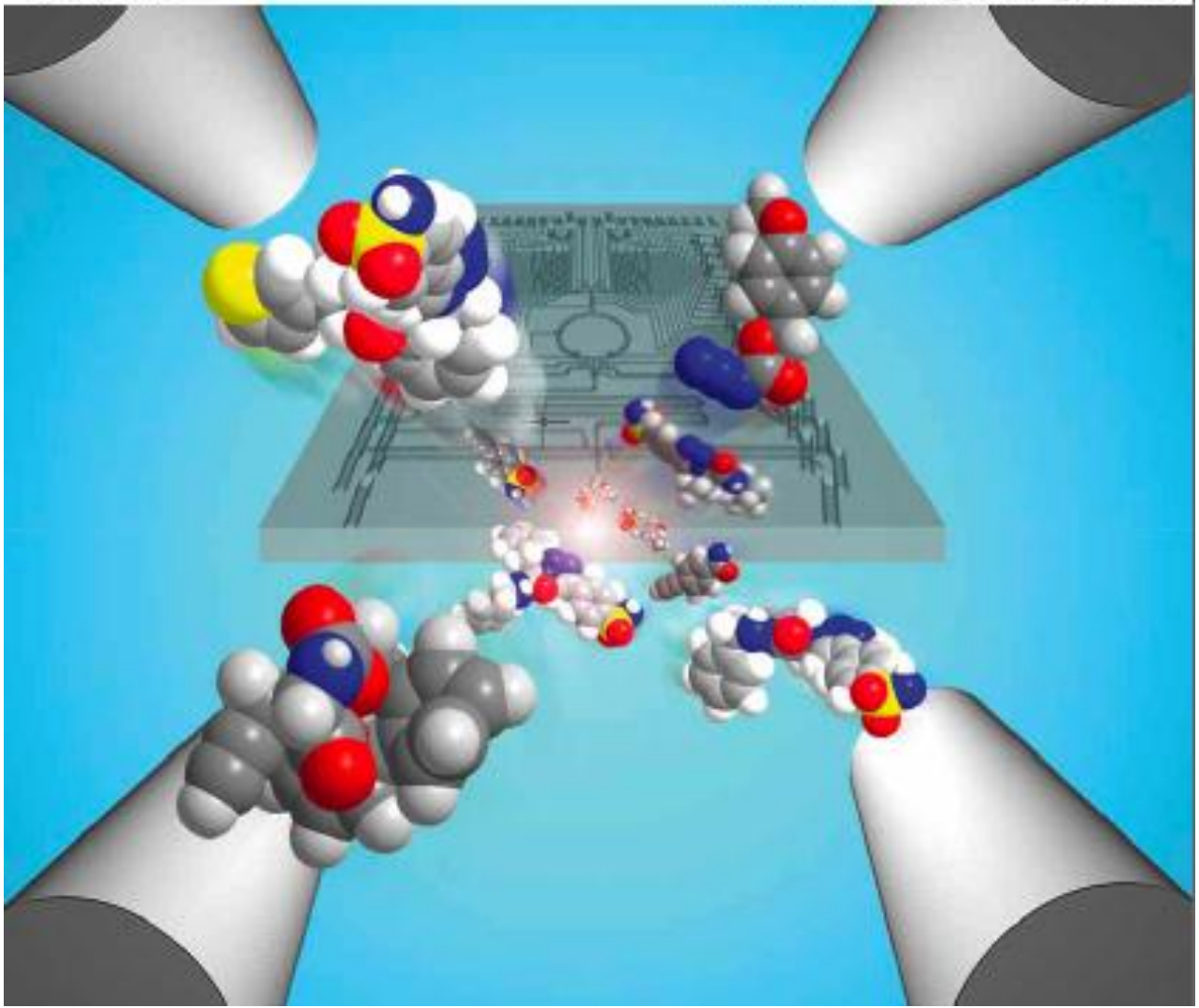
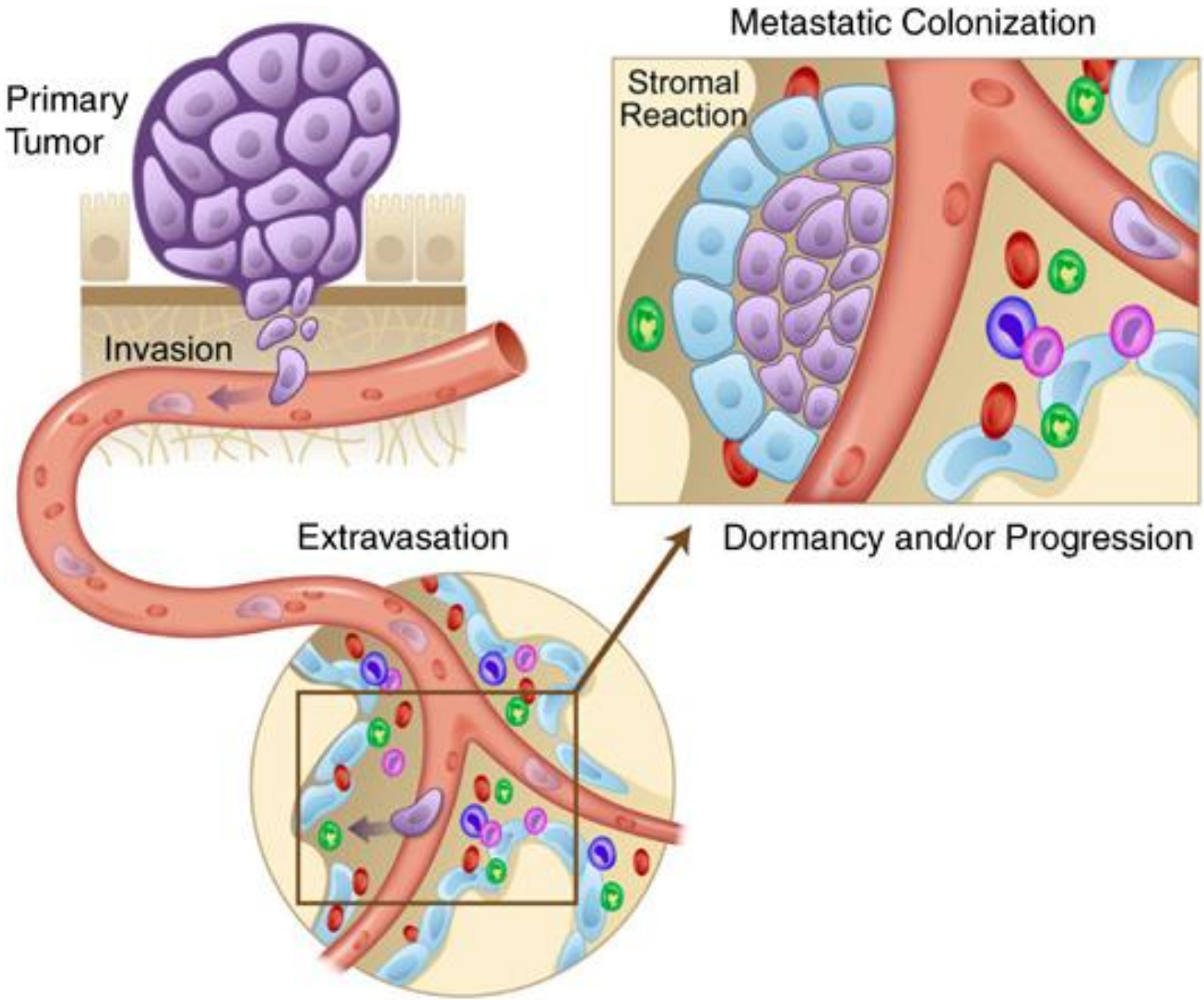
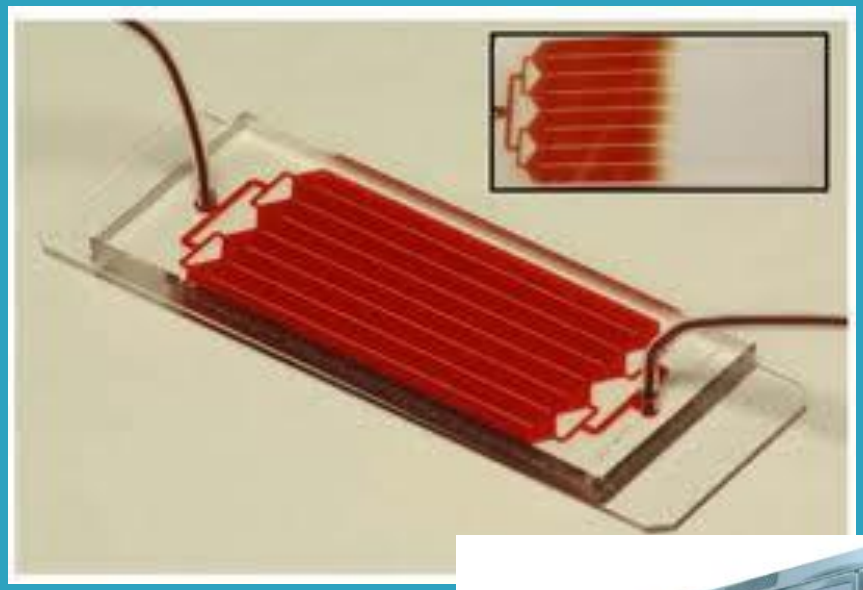
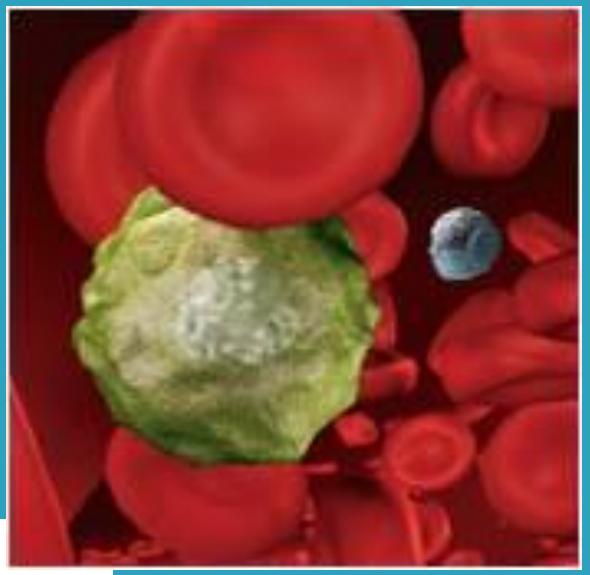


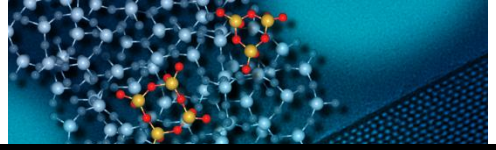
Lab-on-a-Chip


Metastatic Colonization
Primary Tumor
Stromal Reaction
Invasion
Extravasation
Dormancy and/or Progression

Lab-on-a-Chip







NETWORKS

Conclusion

- NIL is an emerging technology that is on the verge of becoming a mainstream manufacturing platform.
- There are several NIL system types and processes to cover a wide range of fabrication requirements
- NIL patterning does (and will) enable a variety of exciting new technologies that will improve our daily lives.

Thank You!!!

Ron Miller

Nanoimprint Lithography Business Development Manager

r.miller@evgroup.com

EV Group, Inc.

How Can We Better Serve You?

Whether you are joining us live or watching the recorded version of this webinar, please take 1 minute to provide your feedback and suggestions.

http://questionpro.com/t/ABkVkZLIdI

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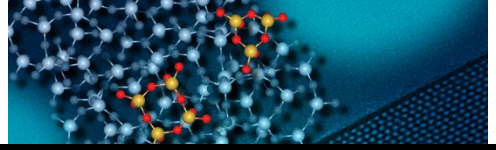

NETWORKS

Thank you for attending the

MATEC NetWorks webinar

Nanoimprinting