PARC Cleantech Innovation Program

TFUG Seminar

February 20, 2008

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About PARC

Incorporated in 2002 as a subsidiary of Xerox

Founded in 1970 as "Xerox PARC"

Recognized leader in research-based innovation

- Known for significant impact in creating modern computing
- Innovation in nearly every Xerox product on the market today
- About 30 new businesses from PARC

Today: Open business model

- Convert advanced research to commercial opportunities
- Seed new growth platforms for our clients

PARC Business Model:

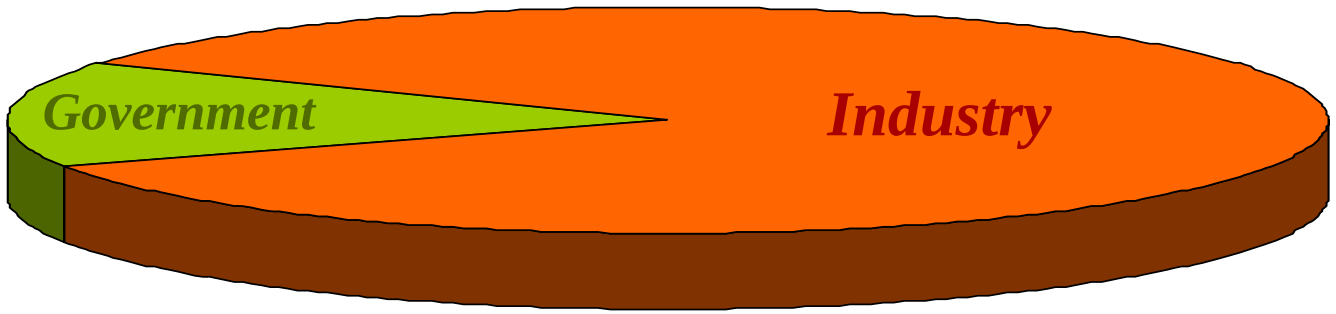
Strategic Focus on Industry Clients

Invest in core research

Develop complementary applications with industry clients

85% of revenue from commercial relationships

- 75% discovery & innovation; 10% licensing



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Facts & Figures

170 researchers, ~ $55 Million Annual Revenue

- Computational, physical, and social sciences

4 research organizations

- Computing Science, Electronic Materials and Devices Hardware Systems, Intelligent Systems
- Cross-division projects are common

1,800 patents and patents pending

- Average 100+ new patents per year 2000-2006

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Interdisciplinary Approach

Information and Communication Technologies

- Human Information Interaction
- Image Analysis
- Intelligent, Autonomous Systems
- Modular Systems
- Natural Language Processing
- Networking
- Security And Privacy
- Sensor Networks
- Ubiquitous Computing

Electronic Materials and Devices

- Flexible electronics
- Large-area Electronics
- Microelectromechanical Systems (MEMS)
- Microfluidics
- Optoelectronics
- Organic Device Design
- Particle Manipulation
- Piezo Materials
- Semiconductor Materials
- Solid-state Electronics
- Thin-film Technologies

Social Sciences

- Discovery of User Needs
- User-centered Design
- Workscapes and organizations

Biomedical Systems (Launched 2002)

- Rare Cell Detection for Cancer
- High-throughput Nanocalorimetry
- de novo Peptide Sequencing
- Continuous Glucose Monitor
- Flow Cytometry

CleanTech (Launched 2005)

- Adaptive Energy Systems
- Algae to Biofuels
- Clean Water
- Demand Response
- Renewable Liquid Fuels
- Solar Energy
- Solid-state Lighting

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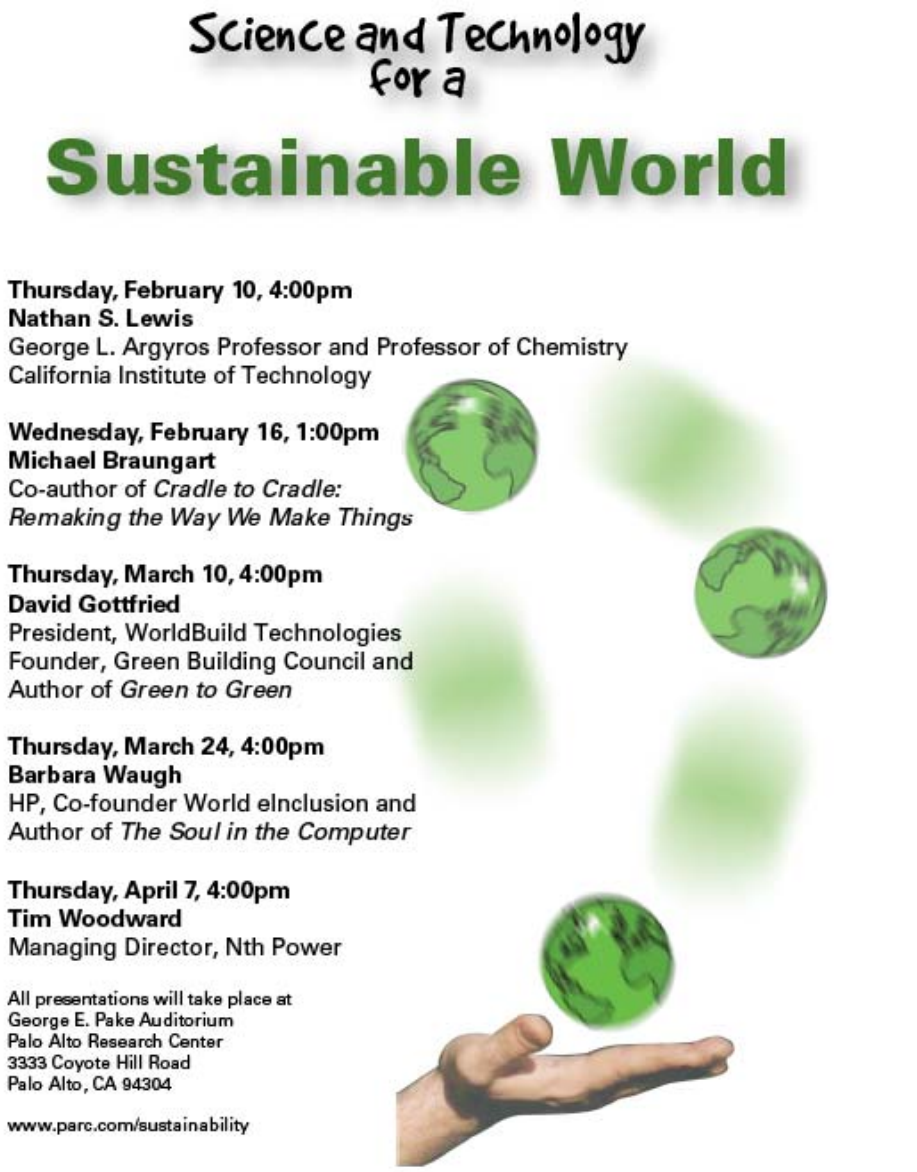
Cleantech Entry

- Cleantech entry was a bottoms-up, researcher driven activity (with management support)
- Researchers organized a speaker series
- Many valuable connections were made



Agilent Technologies EPRI parc UC MERCED XEROX.

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Energy Portfolio Summary

		in progress		completed				
	Concepts	Patents	Modeling	Prototype	Market Assessment	Market Validation	Strategic Partner	Govt Funding
Solar Concentrators								
Printing for Silicon PV								
CO2 Capture								
Adaptive Control: Data Centers								
Adaptive Control: Electrical Grid								
Solid State Lighting								
Printing for Fuel Cells								
Algae to Biofuel								
Transient Documents								

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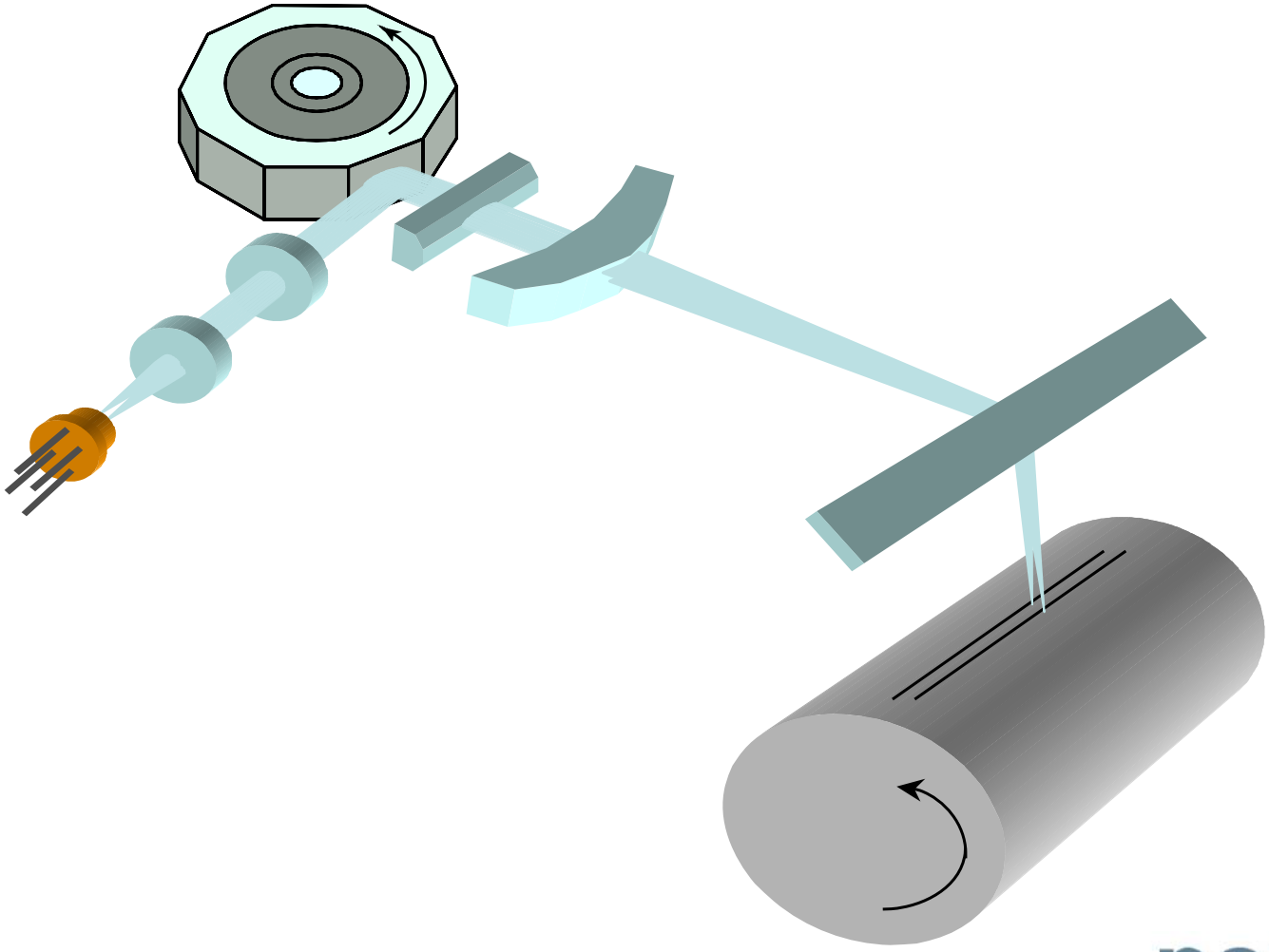
Connecting to a Startup

- Met founders of Solfocus when it was only a two-person organization as part of a visit to a University of California campus
- Learned about their initial design for a solar PV concentrator
- Used PARC know-how in optical systems to propose a much lower cost design
- They became very interested in working with PARC

PARC Expertise in Laser Printing . . .



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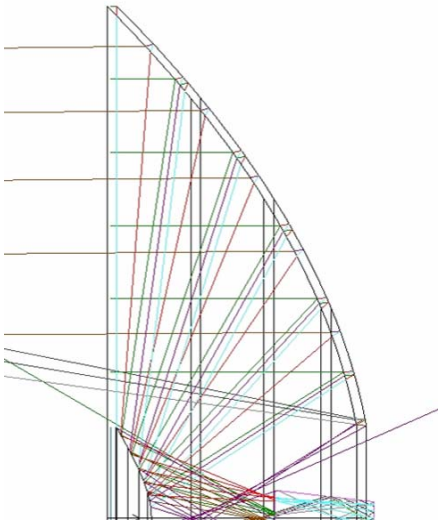
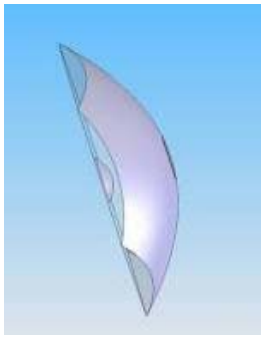
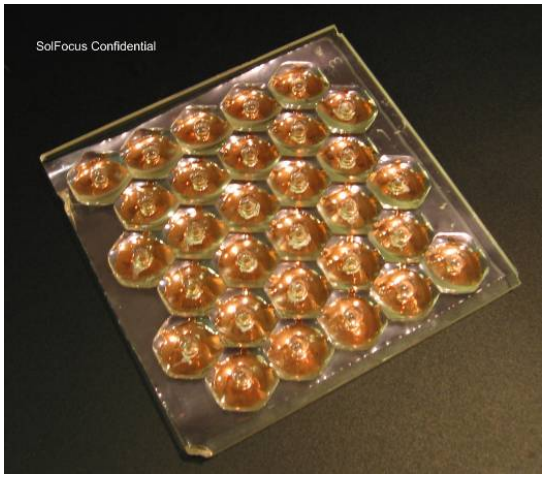
Solfocus Initial Concept

PARC Improvement for Low Cost







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Timeline for the Relationship

Oct, 2004: Trip to visit Professor Roland Winston at UC Merced

- He mentioned the work being done by Solfocus

Dec, 2004: Met Gary Conley (CEO) & Steve Horne (CTO) of Solfocus

- Learned about their 1st generation concentrator

Jan, 2005: Invented a Gen2 concept for a PV concentrator

Jan, 2005: Initial discussion about a possible license

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Dec, 2005: Signed license and research collaboration agreement

Feb, 2006: Solfocus moves into PARC

Aug, 2006: Solfocus closes $32M A-round

January, 2007: Solfocus closes $50M B-round

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Solfocus Relationship

A new model for business engagement

- Understand business/technical problem
- Invent
- File patents
- License technology for equity and royalties
- Incubate the new company inside PARC
- Provide ongoing research support in return for additional equity

License & Research Collaboration Details

- All PARC inventions in the field-of-use of PV concentrators made during the collaboration are exclusively licensed to Solfocus
- Encourages open collaboration, since commercial outlet for the IP is clear
- PARC received equity & royalties in exchange for technical effort of PARC researchers
- Duration of agreement was from October 2005 until August 2007

Other Benefits

- Excitement of having a fast-moving startup company resident at PARC (as high as 50 people at PARC)
- Access to VCs through participation on Solfocus Board of Directors
- Opportunity to engage partners of Solfocus for other projects

UCMERCED
SPECTROLAB
A BOEING COMPANY
moserbaer
NREL
United Technologies
CORNING

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Next Step - Photovoltaics

- Made initial Cleantech bet on concentrator PV with Solfocus
- Wanted to create new projects to address flat-plate silicon (still 95% market share in PV)
- Goal would be to improve efficiency and/or reduce manufacturing cost using PARC competencies (for example printing)
- But we lacked detailed knowledge about the current state of silicon PV

To Rapidly Increase Domain Knowledge, Bring in a Visiting Technologist

Visiting Solar Energy Technologist

Steve Shea
Previously Director of R&D
at BP Solar

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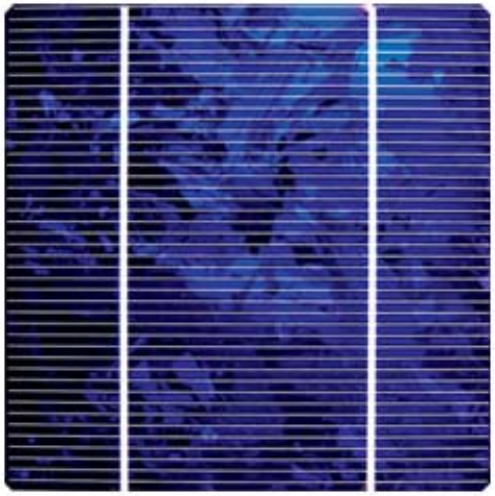
Learn about the Key Business Issues & Current Technical Approach

Efficiency of dominant multicrystalline silicon is low (15%) relative to potential (> 20%)

Need lower cost ($/Watt)

- Diffusion
- Edge Isolation Etch
- Antireflection Coating
- Front Silver Gridline Print
- Back Silver Print
- Back Aluminum Print
- Firing in Furnace



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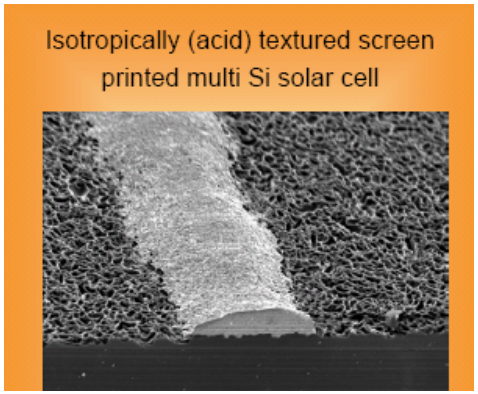
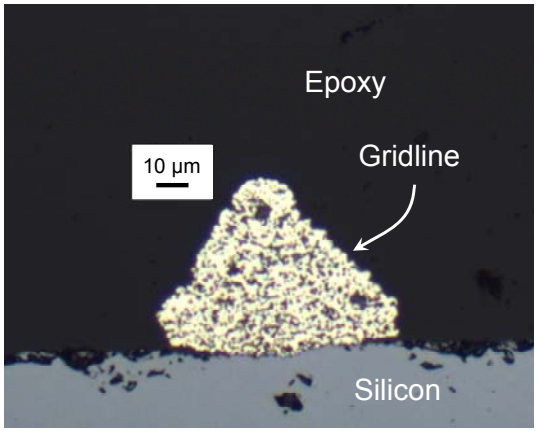
Novel Extrusion Method for Printing Gridlines



Screen-Printed Gridlines
Fired Aspect Ratio = 0.1



PARC Gridlines
Aspect Ratio = 0.8

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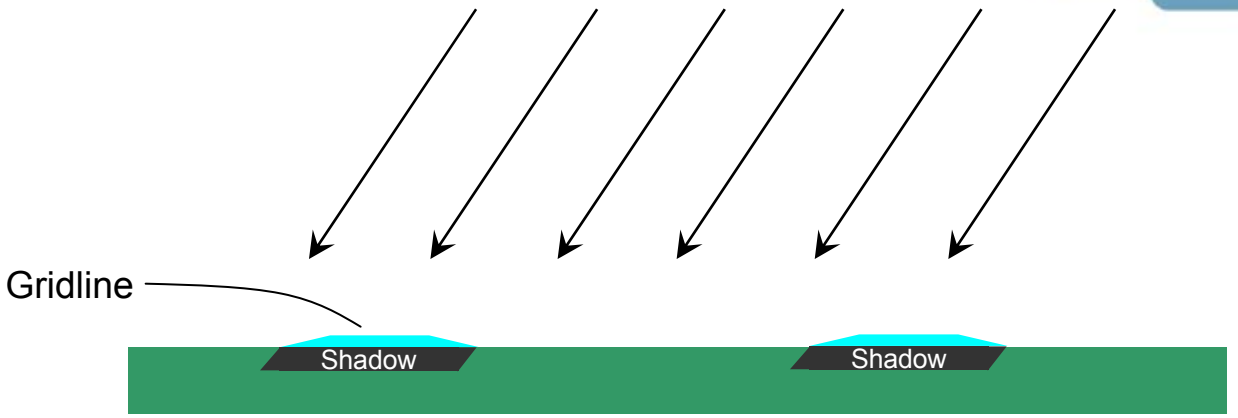
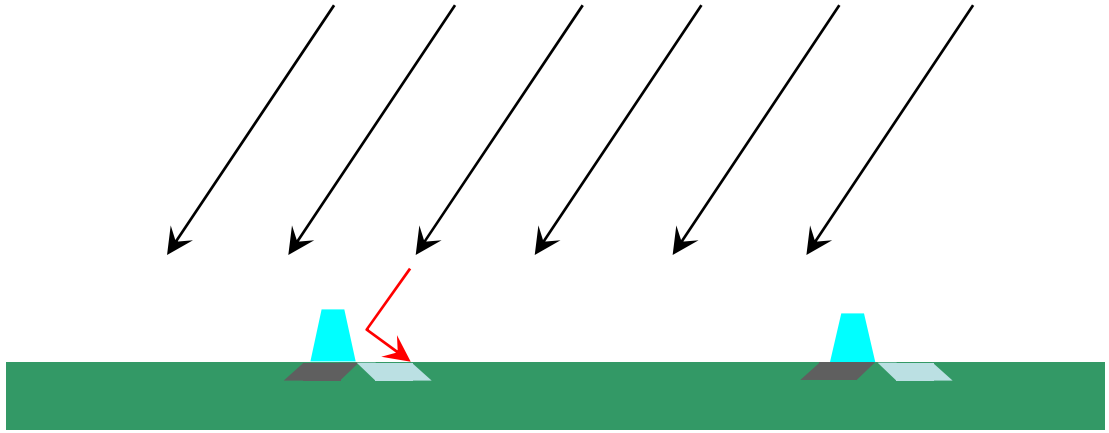


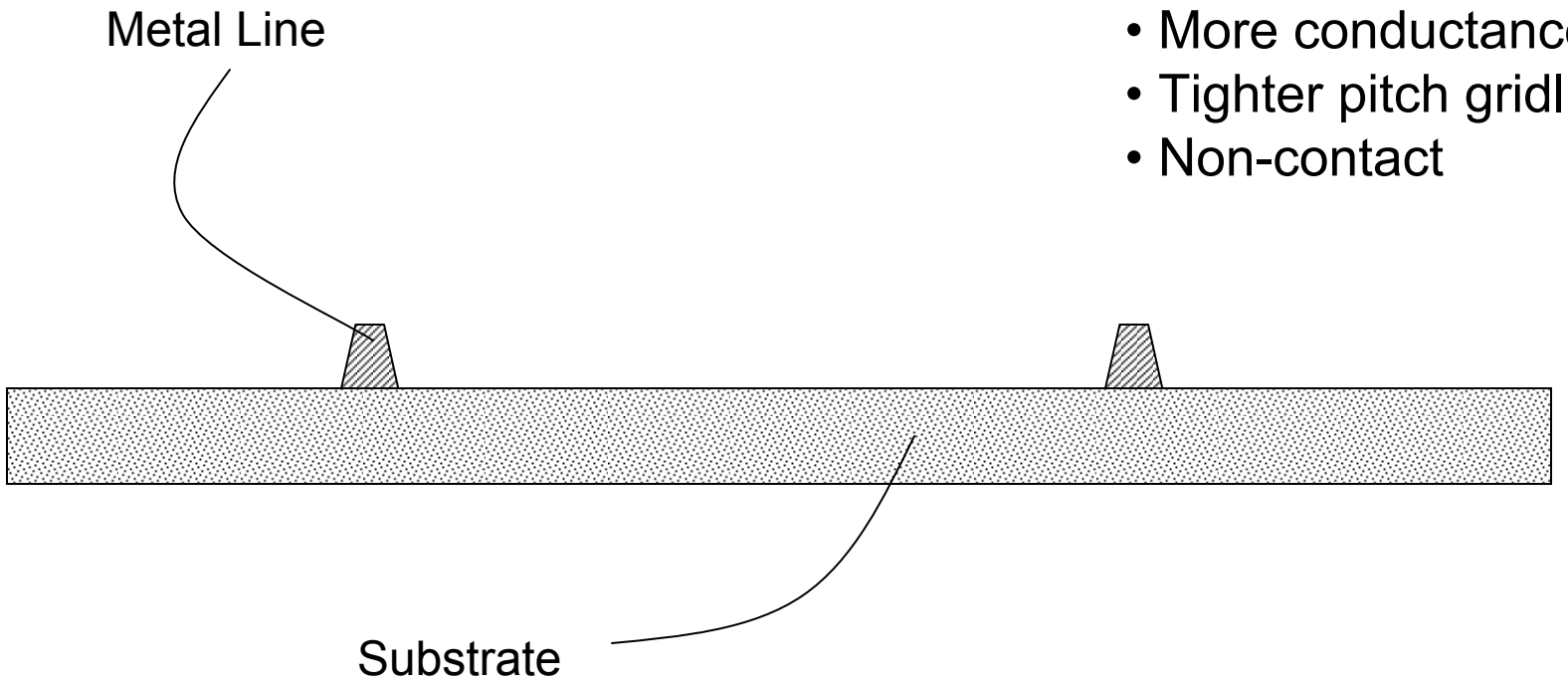


Opportunity: Net Efficiency Increase of 6% Relative

1st Generation Extruded Gridline

Advantages:

- Less shading
- More conductance
- Tighter pitch gridlines
- Non-contact



Target Dimensions:
50 micron height, 50 width
Efficiency increase: ~6% relative for cast multi

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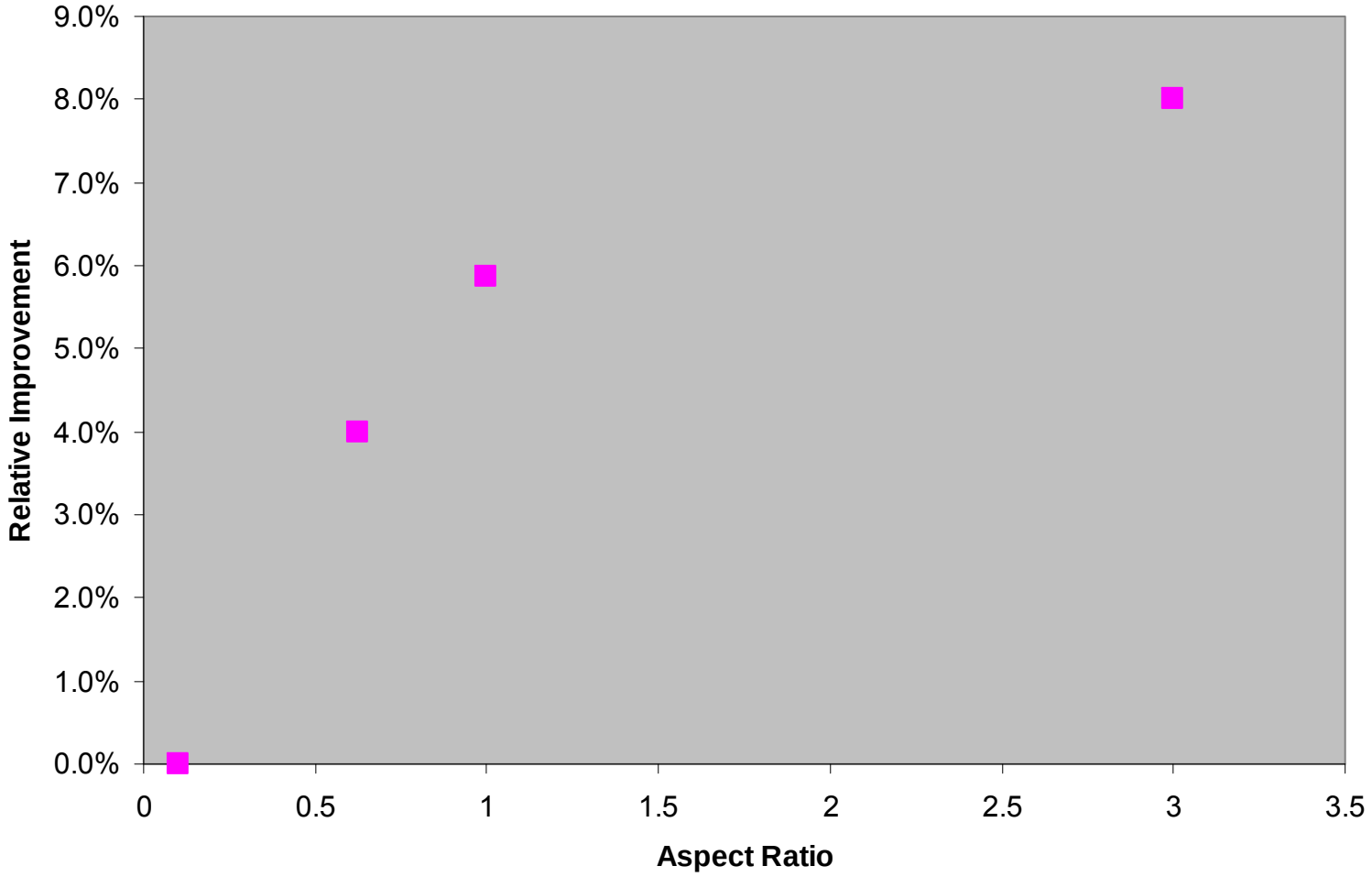
Improvement Versus Gridline Aspect Ratio



Example: Hire an Entrepreneur in Residence to Bring Focus to Commercialization

Entrepreneur in Residence

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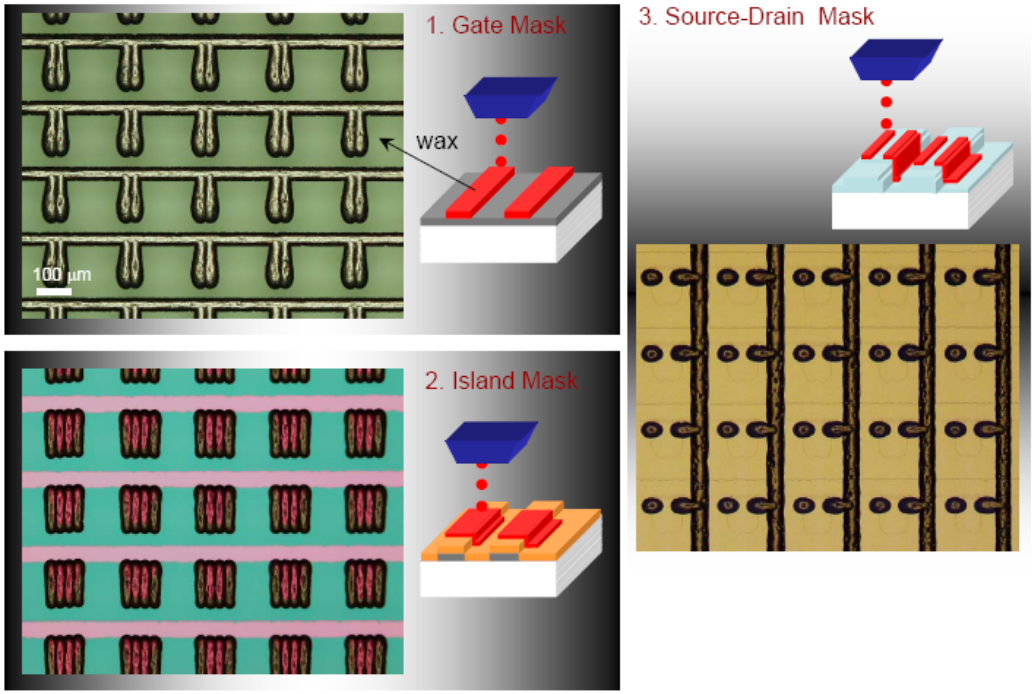
PARC's Focus in Ink Jet Printing for Electronics

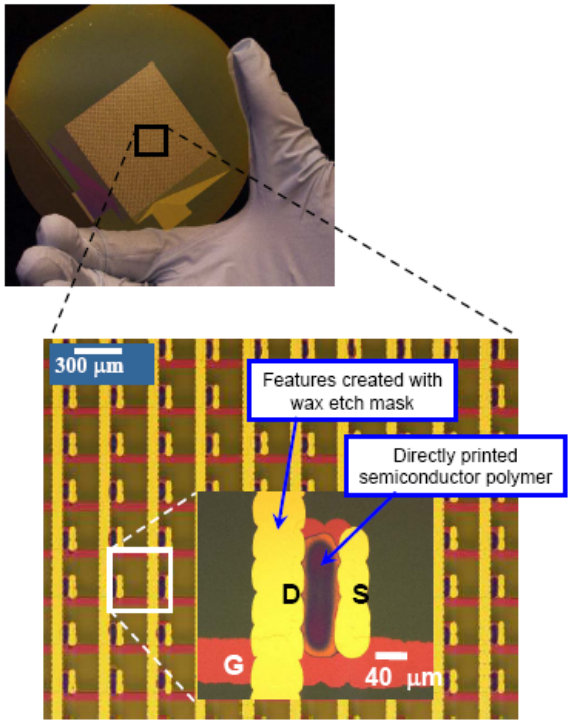
Research on active matrix backplanes for LCD and E-Paper

> 30 patents and patents pending

Etch Masks for TFT Fabrication



Polymer Semiconductor Printing



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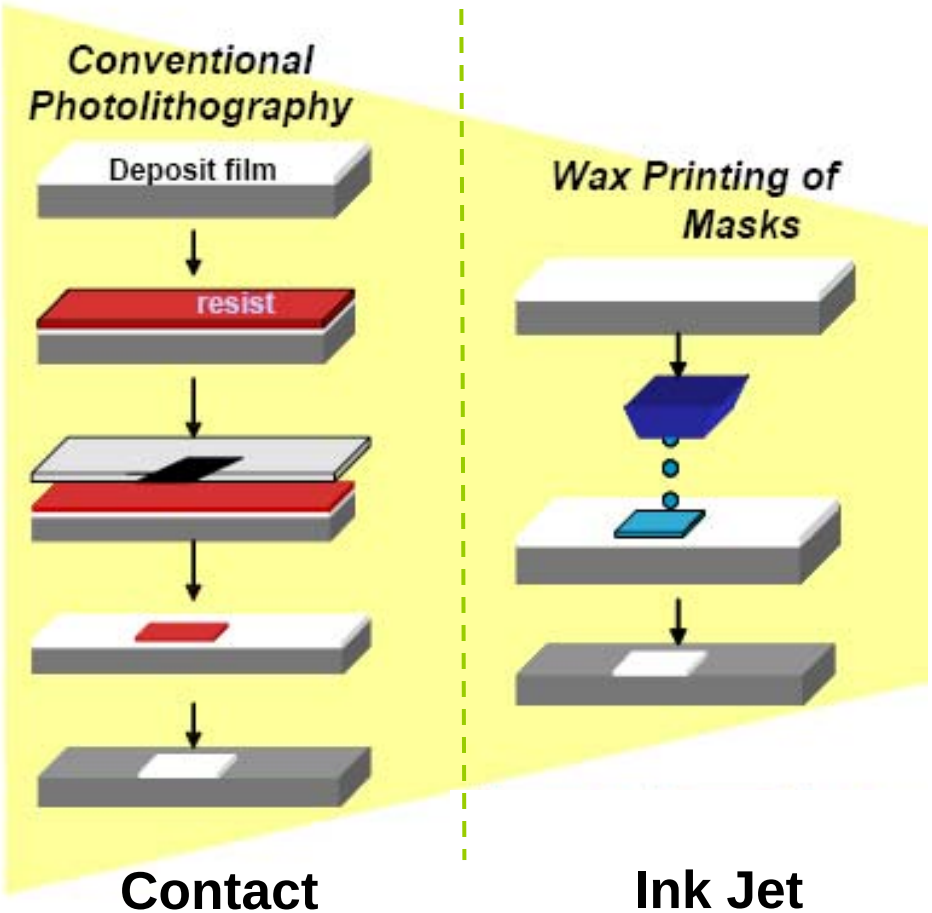
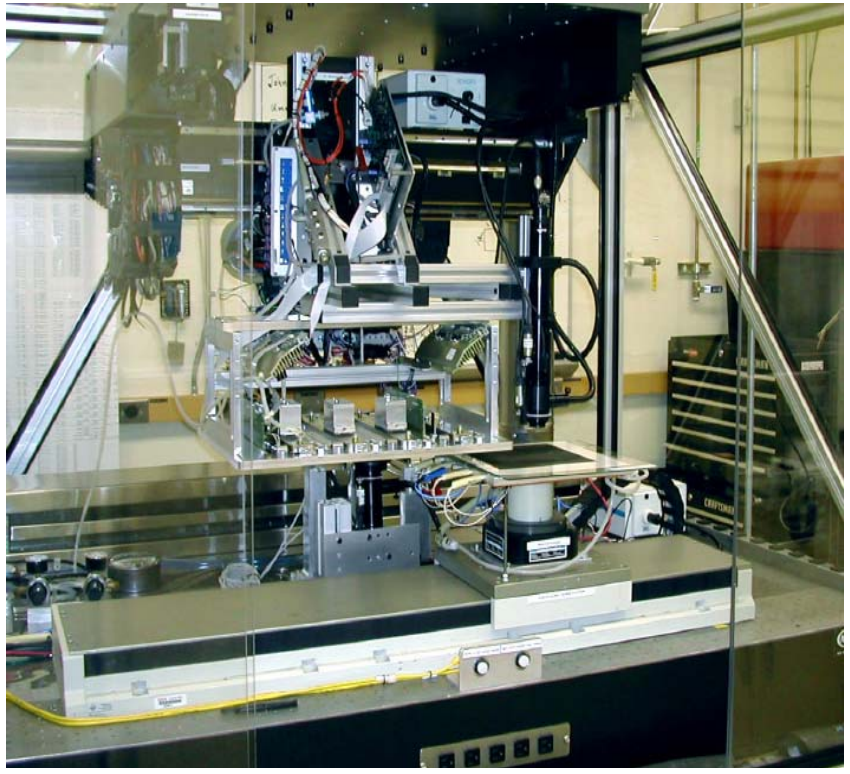
Wax Resist Patterning





Contact Imaging

Ink Jet Imaging

PARC Prototype

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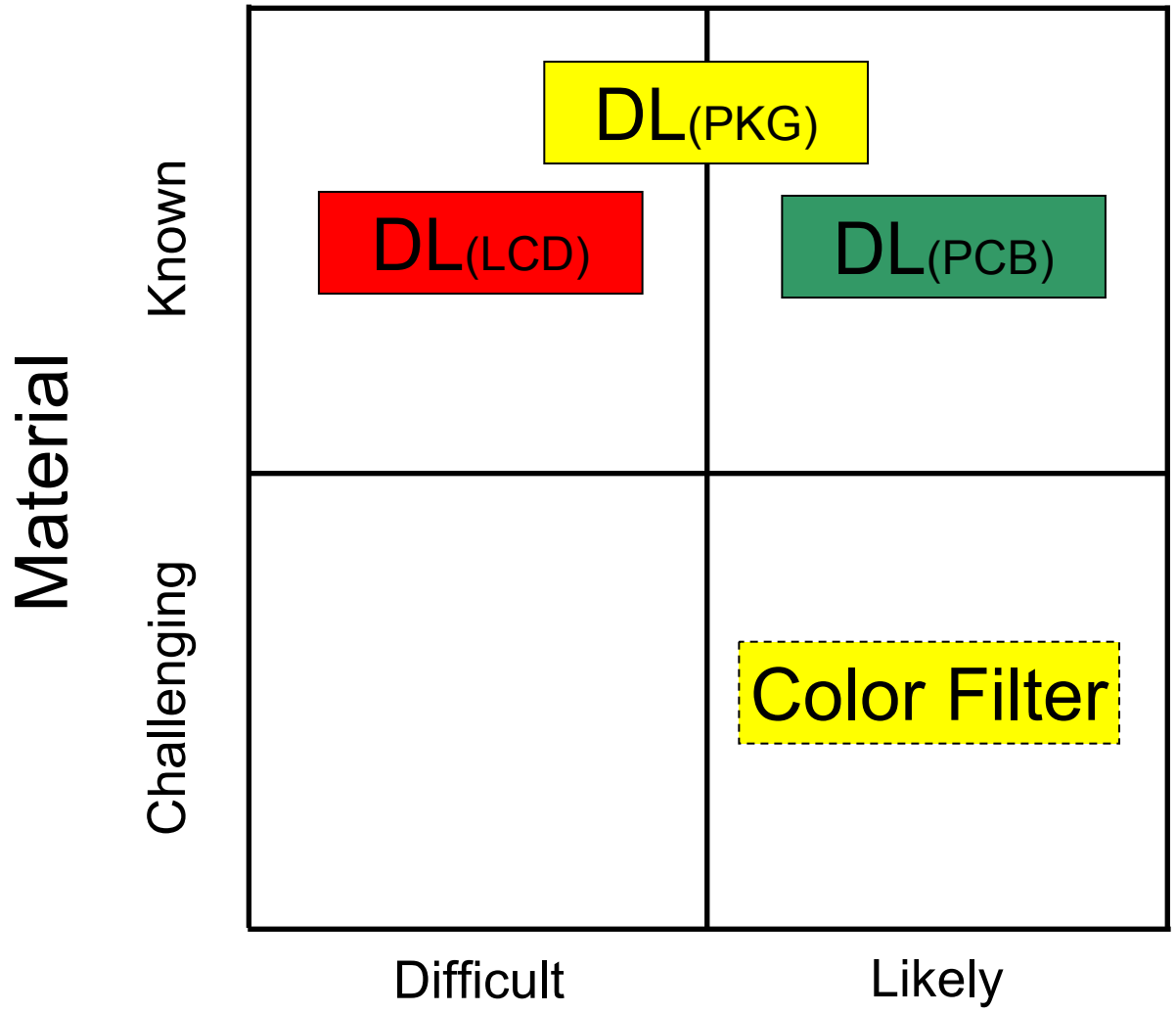
Digital Lithography (DL) Applications



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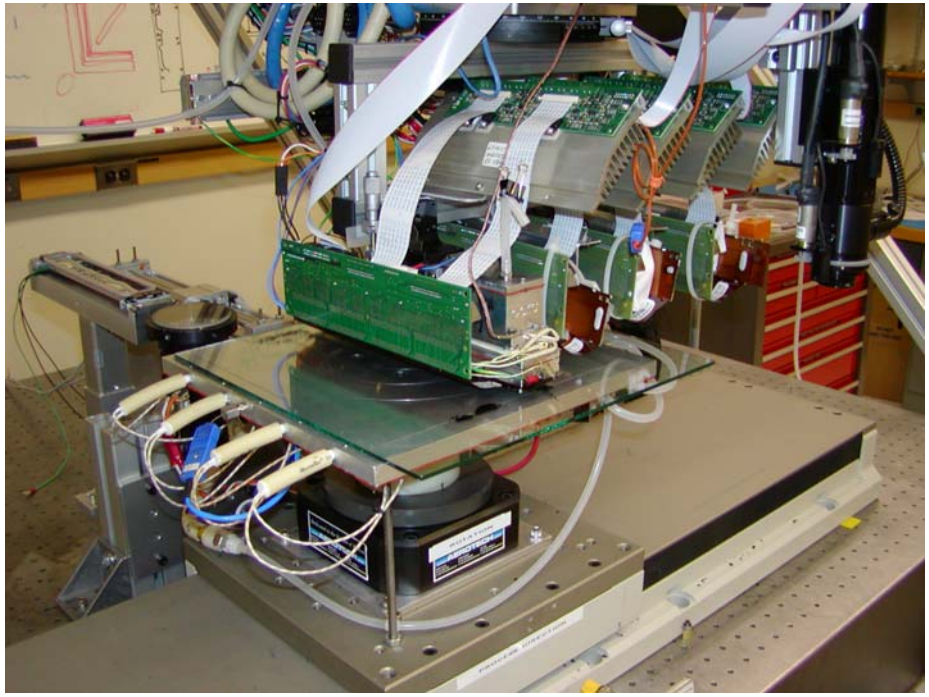
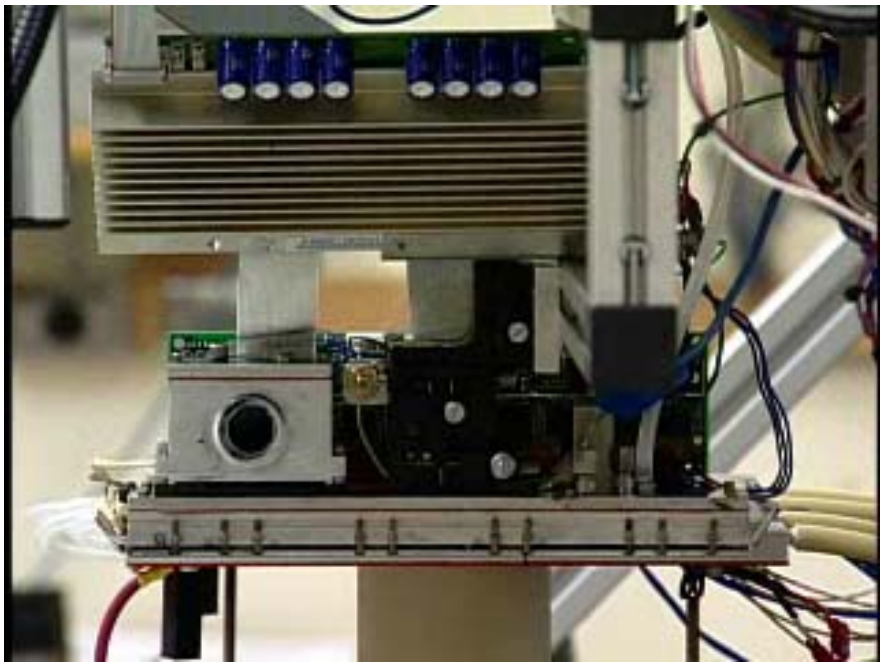
Speed Patterning Demonstrated

Video



4 printheads in tandem



1 printhead

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Market Segmentation by Feature Size

Fabrication Technology	Substrate	Metal	Photoresist	ICs	LCD	Substrates	Semi-conductor Packages	PDP	Flexible / Rigid-Flex Circuits	Printed Circuit Boards (PCB)
RIGID Organic ("Printed Circuit)	FR4	Copper (RA, or EP)	Dry Film, Liquid							
Flexible Organic ("Printed Circuit)	Polyimide	Copper (RA, or EP)	Dry Film							
FPD	Glass	ITO, CU	Liquid							
Wafer based	Silicon	Cu, Al, Au	Liquid							
Min. Feature Size				**<0.1 um**	**5 - 15 um**	**20 - 38 um**	**25 - 130 um**	**40 - 90 um**	**50 - 100 um**	**75 - 200 um**

PARC/Xerox Capability

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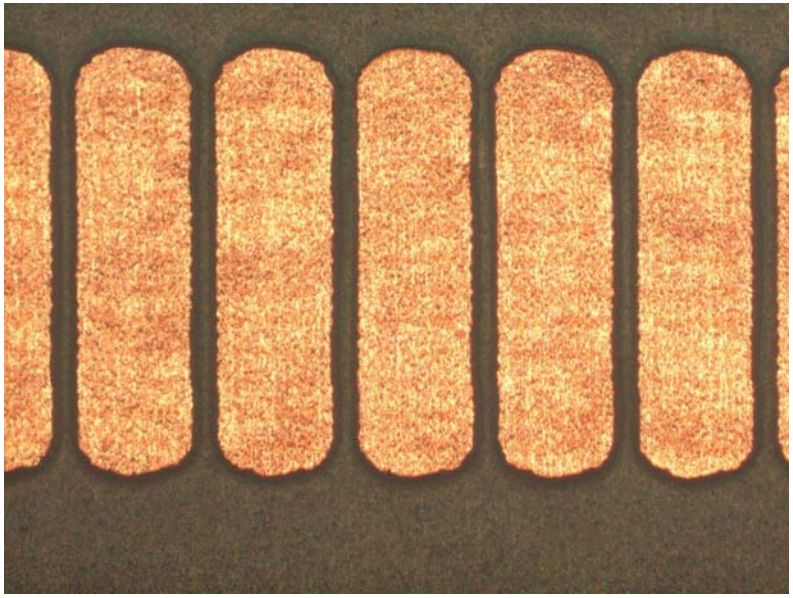
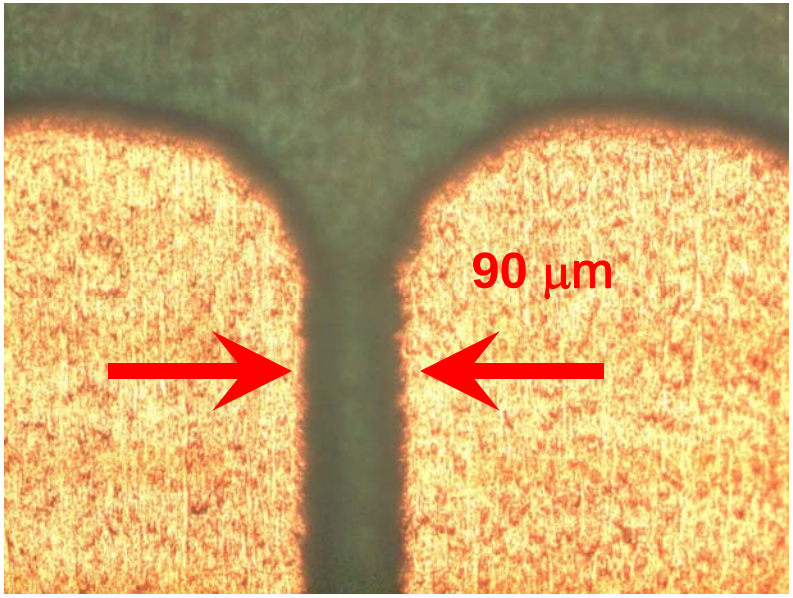
Soldermask Imaged by Inkjet





Close-up

Image Parameters:

- Copper substrate
- 40 μm thick conventional Soldermask

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Summary

Engaging in multiple forms of partnership has accelerated the value creation process enormously

- *Startups*
- *Visiting technologists and entrepreneurs*

Flexibility in IP arrangements was key to creating the most value for all parties

Encouraging a climate of openness and experimentation with both technologies and business models is essential

Co-location has not only helped speed the value creation process, but has helped the cross-fertilization of ideas