Center for BioModular Microsystems (www.lsu.edu/cbmm)

Goal for our BRP: **Develop modular, high throughput polymer-based microfluidic devices for molecular profiling of colorectal cancers (funded – 1999).**

Microfabrication

Michael Murphy
Dimitris Nikitopoulos
Kevin Kelly
Wanjun Wang
Jost Gottert
Steven Soper
LSU-ME, CHEM, CAMD

Materials

Robin McCarley
David Spivak
Robert Hammer
(LSU-CHEM)

Molecular Biologists Clinicians

Francis Barany
Pat Paty
(Cornell Med.)
(Sloan Kettering)

ACCOMPLISHMENTS: >35 publications; support of 8 Ph.D.s, 7 M.S., 1 RA; minority supplements; new efforts: R21/R33 - microsystems for breast cancer; NSF EPSCoR - infrastructure developmental award (microsystems resource center).

INSTITUTIONAL COMMITMENTS: New building; State support of new technicians (electronics and micromilling); new major equipment; X-ray lithography at CAMD (www.camd.lsu.edu); expansion into nanofabrication.

Microfabrication: Creating new tricks for well-defined techniques

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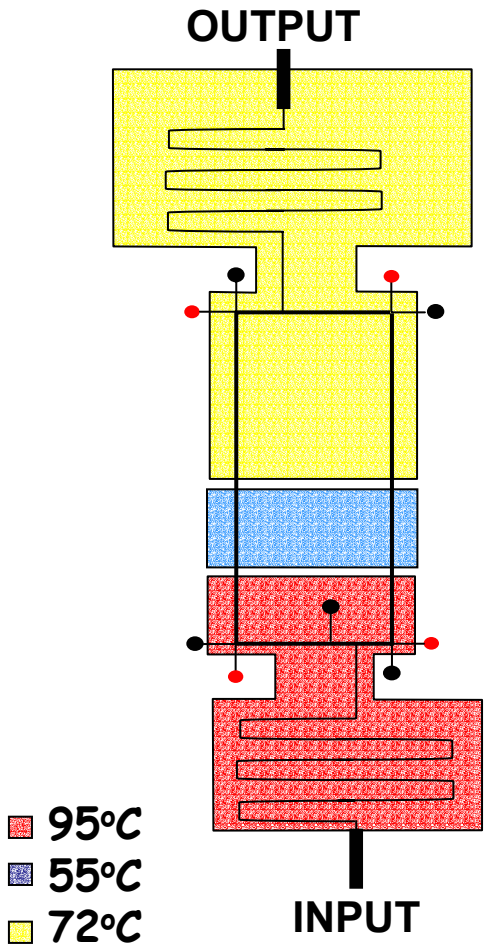
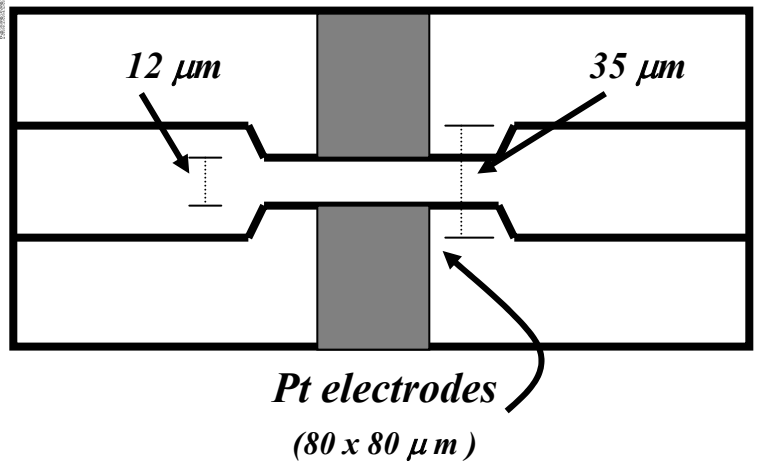
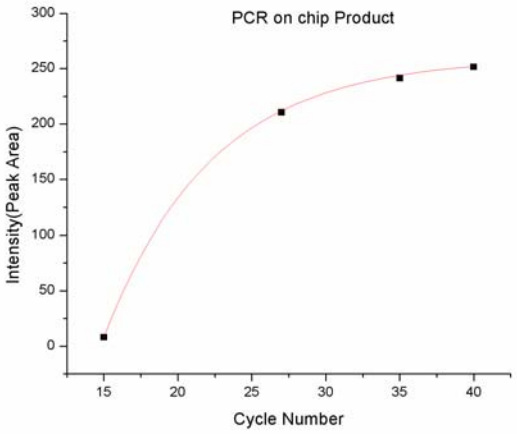
Synchronized Cyclic PCR



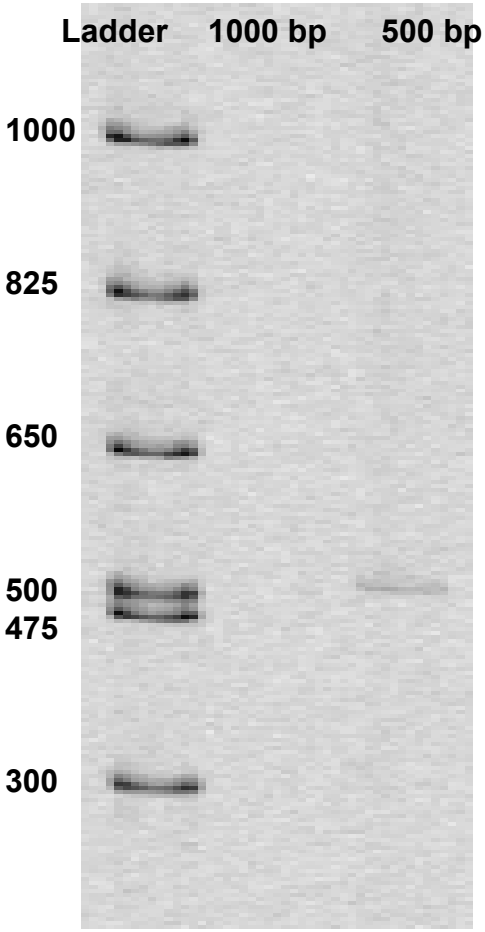
Label-less Readout Contact Conductivity



Real Time PCR



Ultra-fast PCR



-20 cycles in 1.7 min (500 bp)
-20 cycles in 3.9 min (1000 bp)

Making Polymers Work for You!

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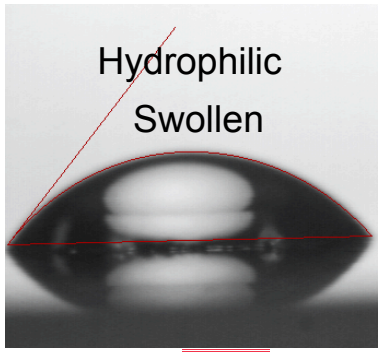
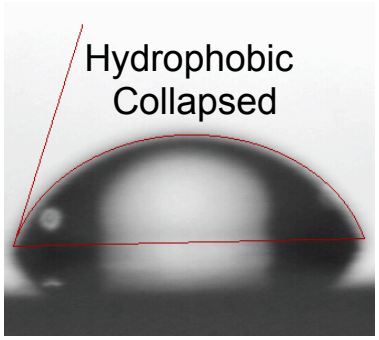
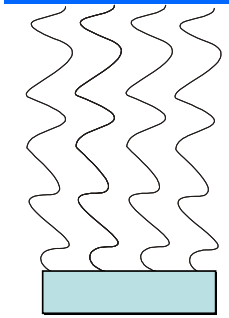
pNIPAM Thermally Responsive





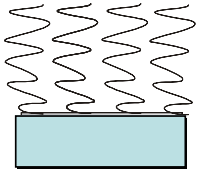
$T = 22^{o}C$

< LCST

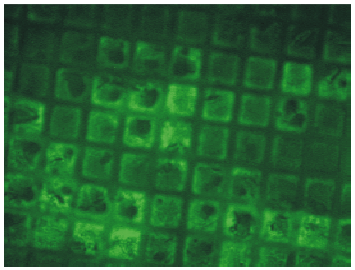


$T = 40^{o}C$

> LCST

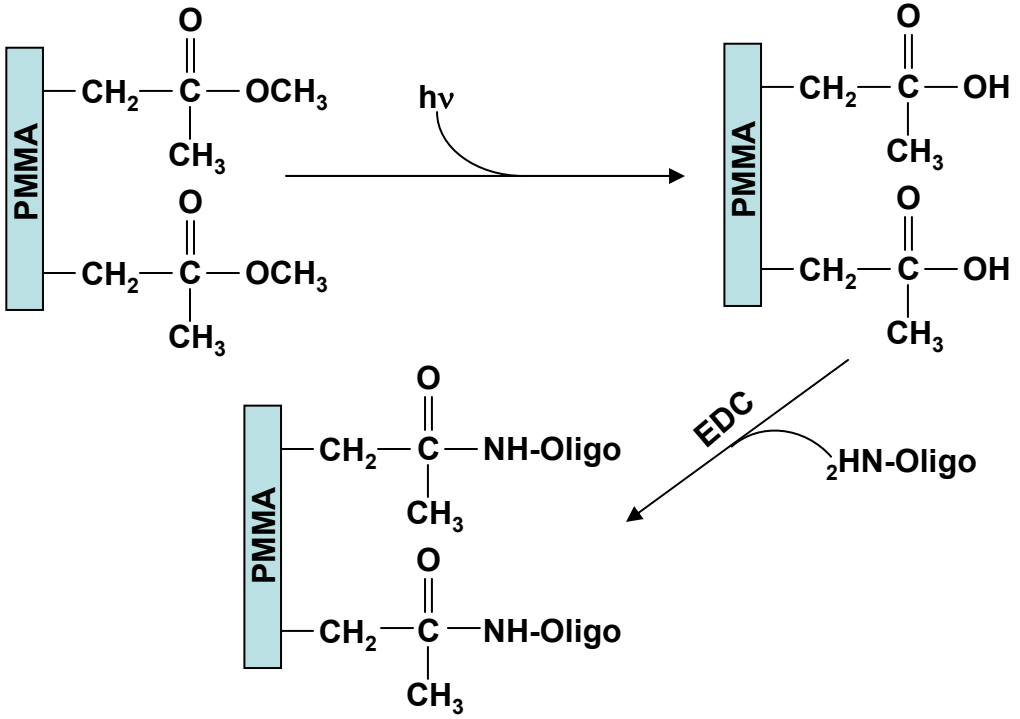


0.5 ˚C

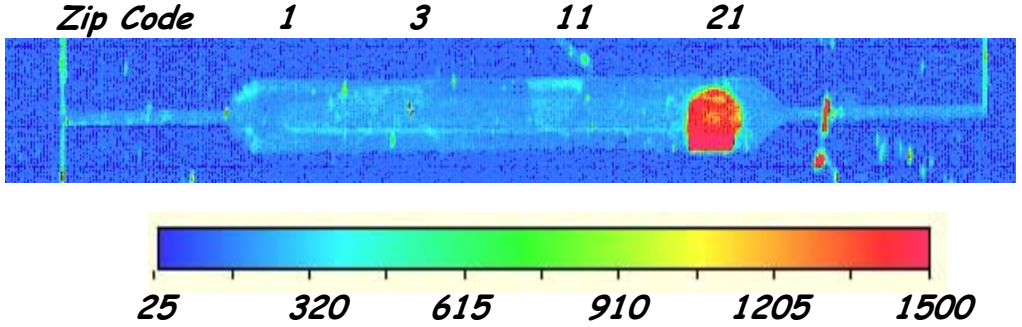


40 ˚C

UV Patterning of Functional Scaffolds



Fluorescence Image of Microfluidic Array



Thematic Organization for BRP Renewal: Real-Time Molecular Forecasting

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Diagnosis

High Copy Number, High Purity

Molecular Profiling of Solid Tumors

Personalized Treatment

Early Detection

Low Copy Number, Low Purity

Molecular Profiling of Low Abundant Cells

Preconcentrate Target Cells
Remove WBCs or stromal cells

LOH → LDR/PCR/LDR/Electrophoresis (allele specific mobilities)

Methylation Patterns
- → Bisulfite/PCR-PCR/ LDR/Un. Array
- → Bisulfite//mPCR-PCR/ Universal Array

Mutational Analysis
- Known Mutations
  - → mPCR-PCR/ FEN-LCR/spFRET
  - → PCR-PCR/LDR/ Universal Array
- Unknown Mutations
  - → PCR/ENDOV/LDR/ Electrophoresis

Copy Number Changes → mPCR-PCR/ LDR-FRET

Molecular Profiling for Early Detection (PCR/PCR/FEN-LCR-spFRET)

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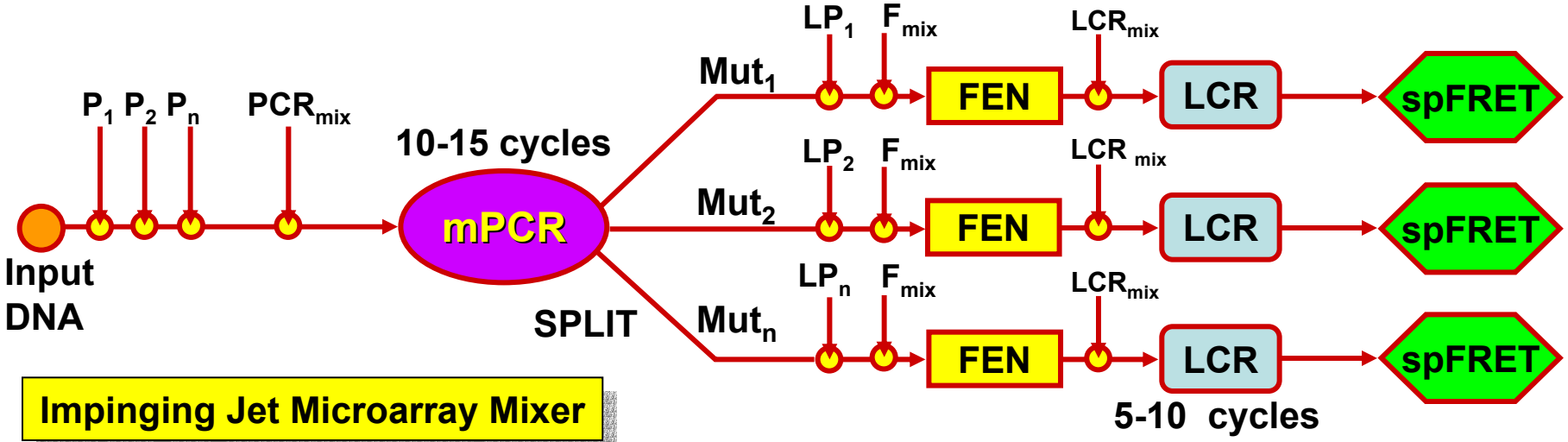
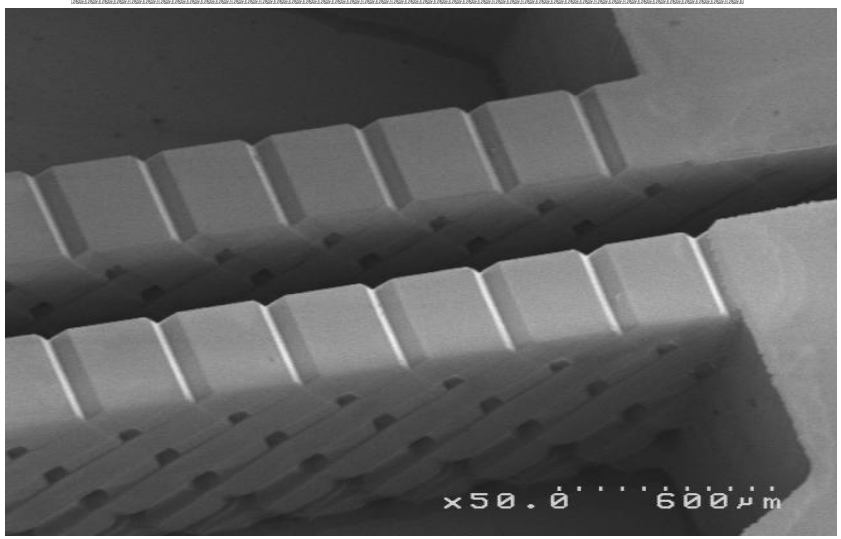
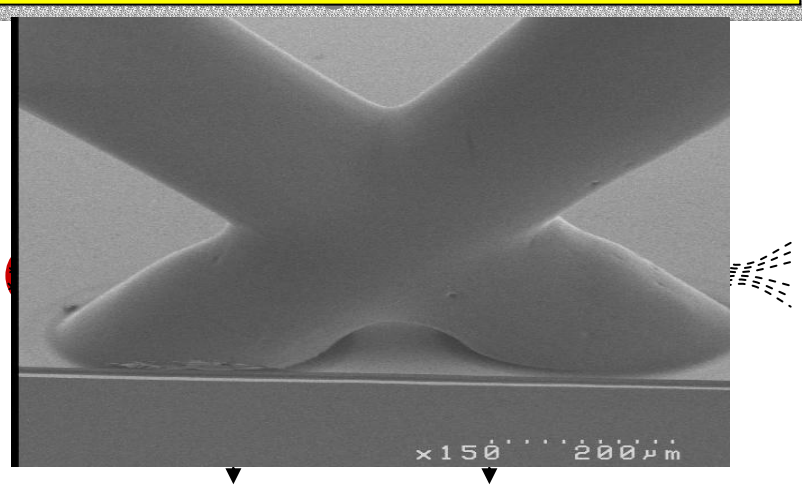
Goal: Screen for many mutations in rare cells from mixed populations.
Required – high specificity; high sensitivity.



Impinging Jet Microarray Mixer



Multichannel Single Molecule Detection