

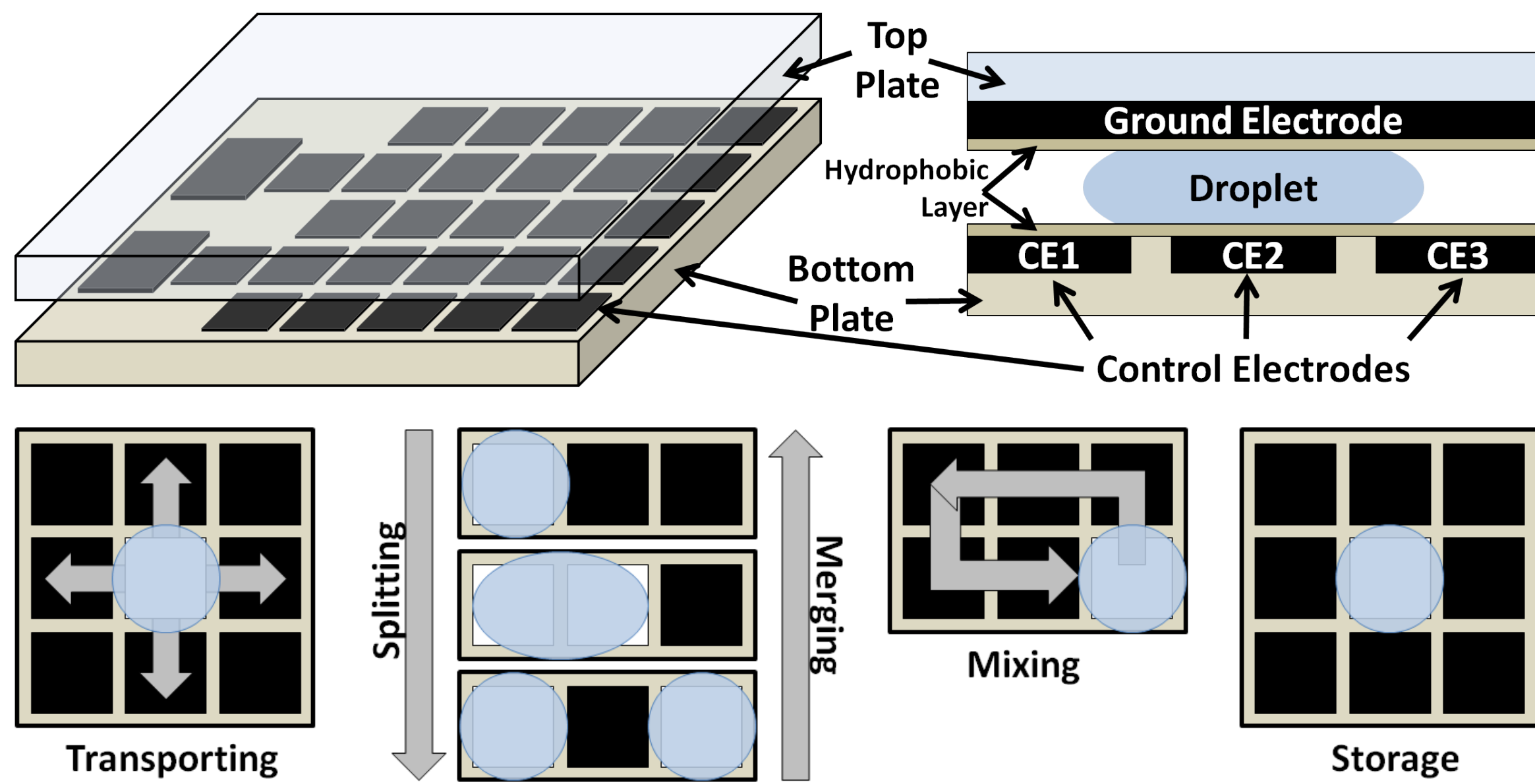
Cyber-physical Digital Microfluidics based on Active Matrix Electrowetting Technology: Software-programmable High-density Pixel Arrays (#1545907, #1544686)



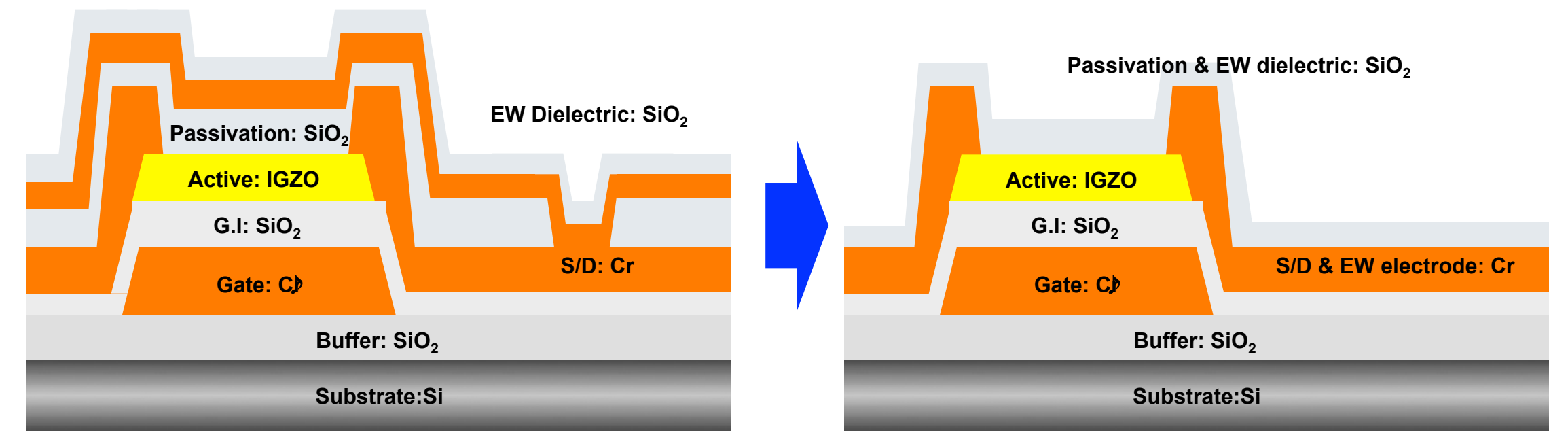
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Philip Rack (University of Tennessee)



Digital Microfluidic Technology



Simplify device fabrication process



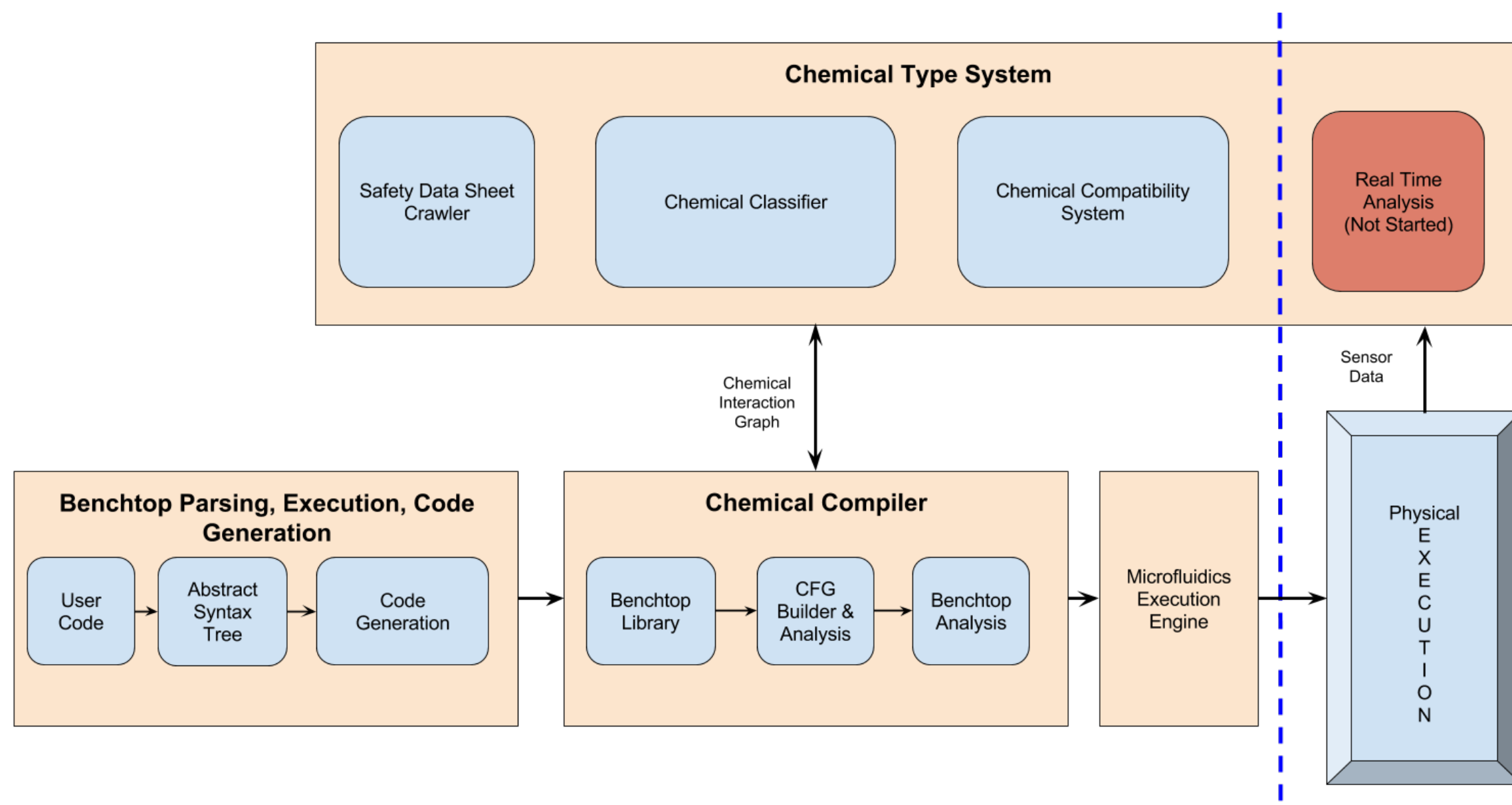
6 Mask process step

1. Gate (mask 1)
2. Gate insulator
3. Active (mask 2)
4. S/D electrode (mask 3)
5. Passivation
6. Via hole etching (mask 4)
7. EW electrode (mask 5)
8. EW dielectric
9. Contact pad open (mask 6)

4 Mask process step

1. Gate (mask 1)
2. Gate insulator
3. Active (mask 2)
4. S/D & EW electrode (mask 3)
5. Passivation
6. Contact pad open (mask 4)

Microfluidic Benchtop Language Overview



Microfluidic Benchtop Language Example

Experiment : Simple PCR

Required Reagents :

Buffer = 100μL of Buffer Solution

PCR Master Mix = 500μL of DNA Solution

Instructions :

DNA Mixture = Mix Buffer with PCR Master Mix at 98°C for 50s

Repeat 50 times {

Heat DNA Mixture at 68°C for 45s

Heat DNA Mixture at 98°C for 5min

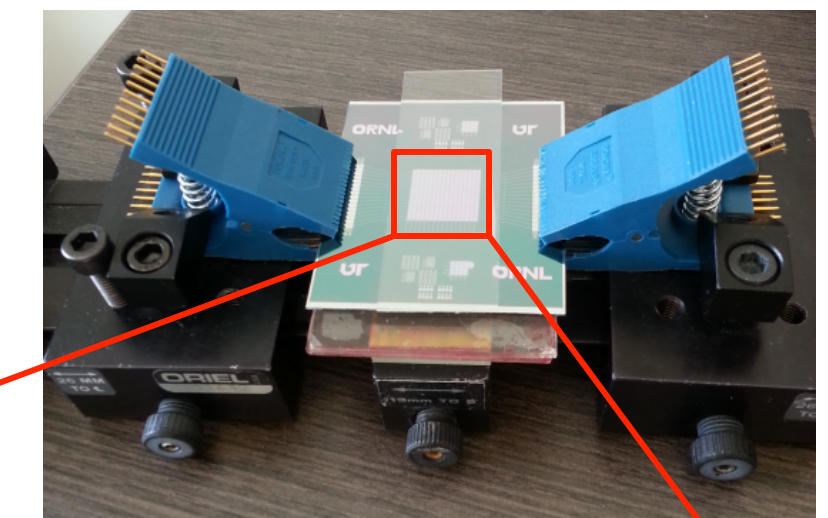
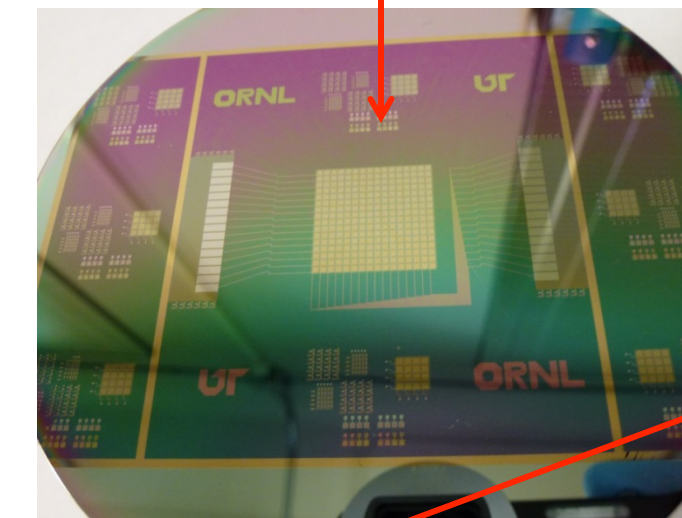
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DNA Reading = Measure the fluorescence of DNA Mixture for 10s

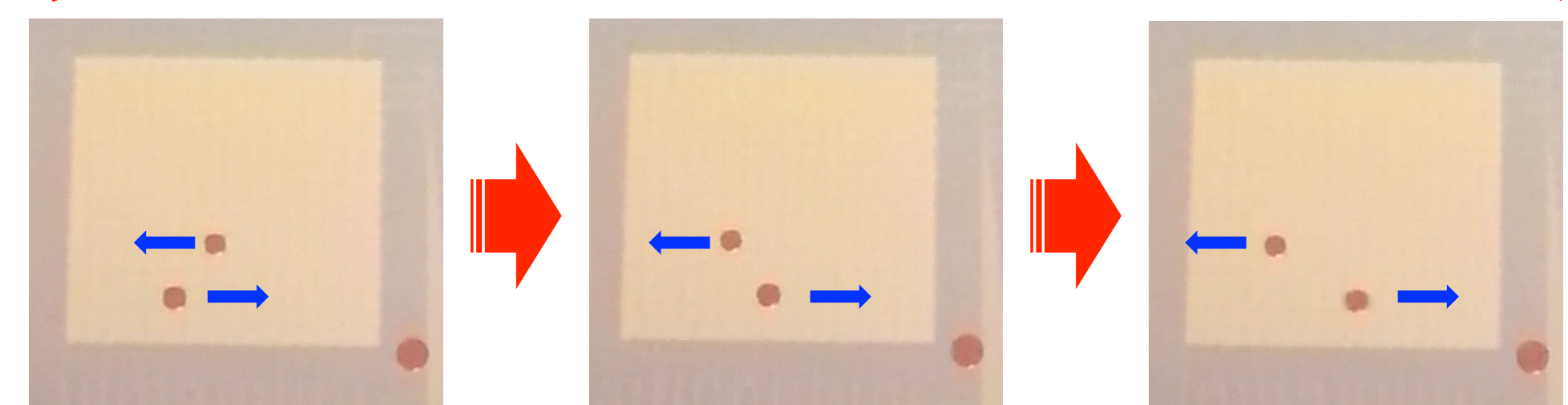
Save DNA Mixture

Active Matrix Driven Electrowetting array

16 x 16 electrodes array



Parallel 2 droplets manipulation



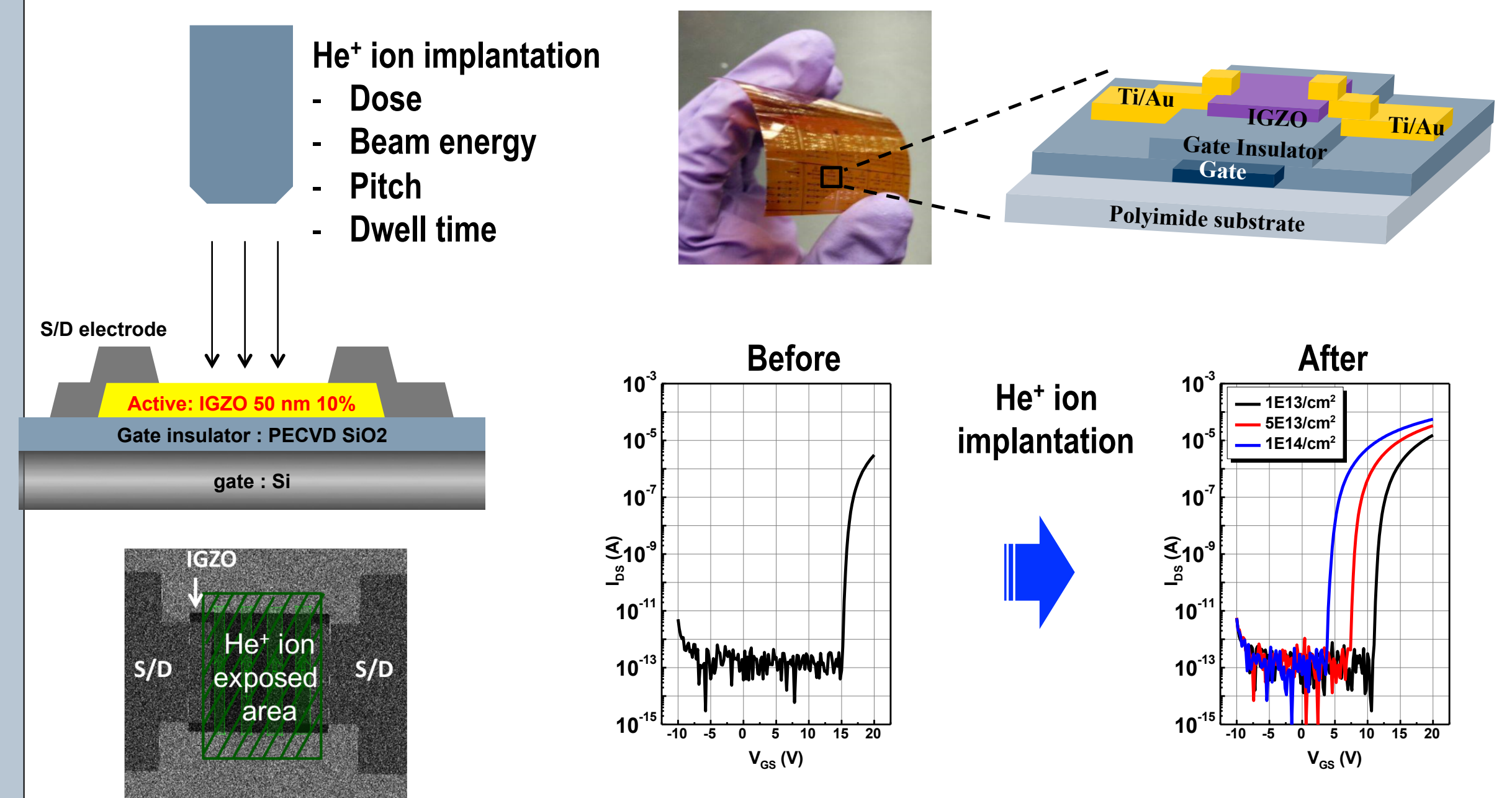
Athermal Activation of IGZO TFT for flexible device application



IGZO TFT activation : 250°C thermal annealing

→ Most polymer substrate cannot be survived

→ Athermal activation using He⁺ ion implantation



Digital Microfluidic Execution

