

# Magnetohydrodynamic-Based Circular Liquid Chromatography On-Chip

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## IMPACT

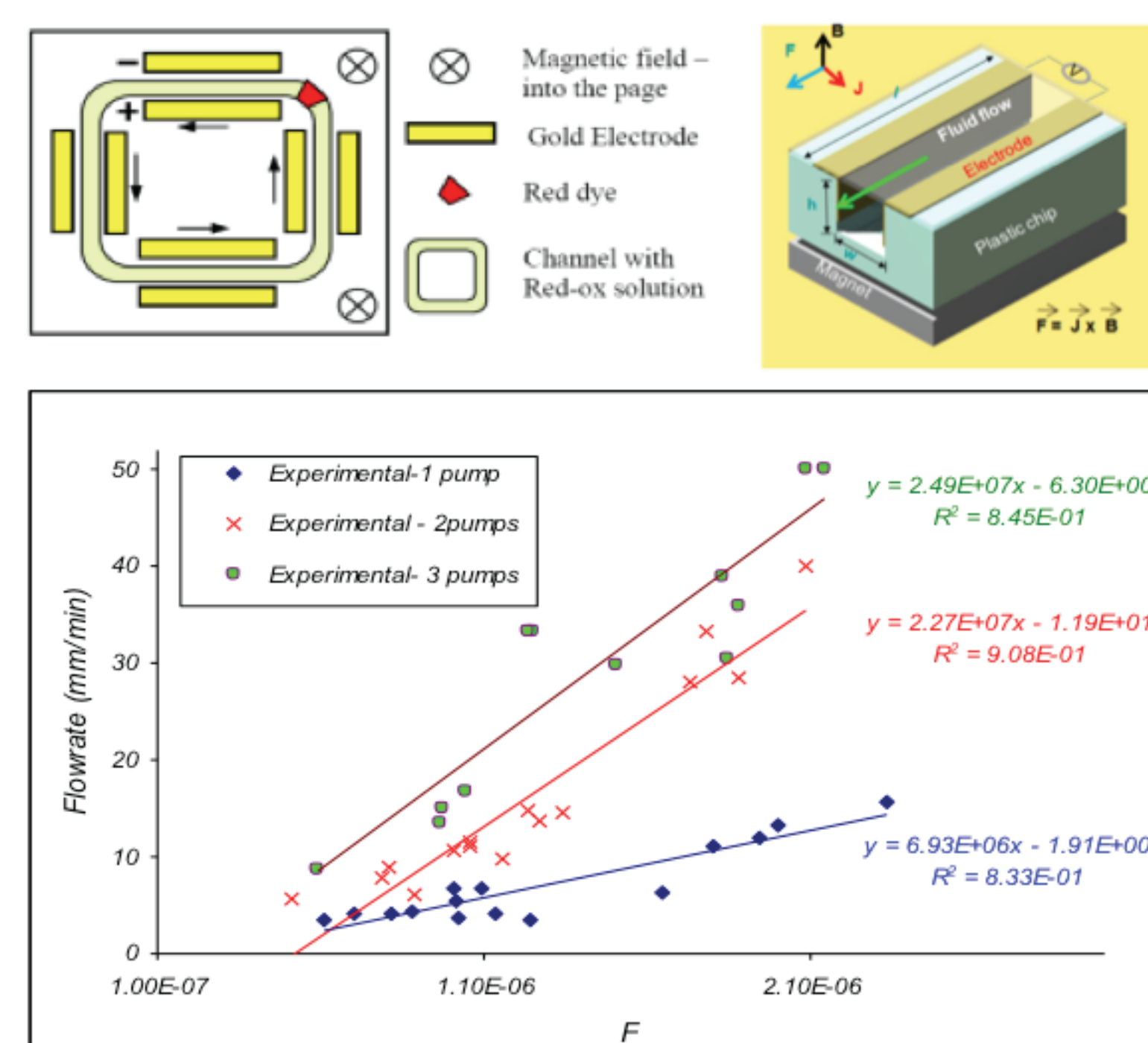
- Separation in a circular format gives infinite separation distance
- Dynamic on-column detection
- Direct integration with other on-chip functionalities
- Overall benefits to society includes system portability and possibility to integrate with other separation systems

## NOVELTY

- MHD mPump® is integrated within a chip
- mPump network can perform all aspects of separation inside sealed chip: sample loading, injection, separation etc.
- All reagents, waste separation and detection inside sealed chip
- Real-time in-column imaging/detection

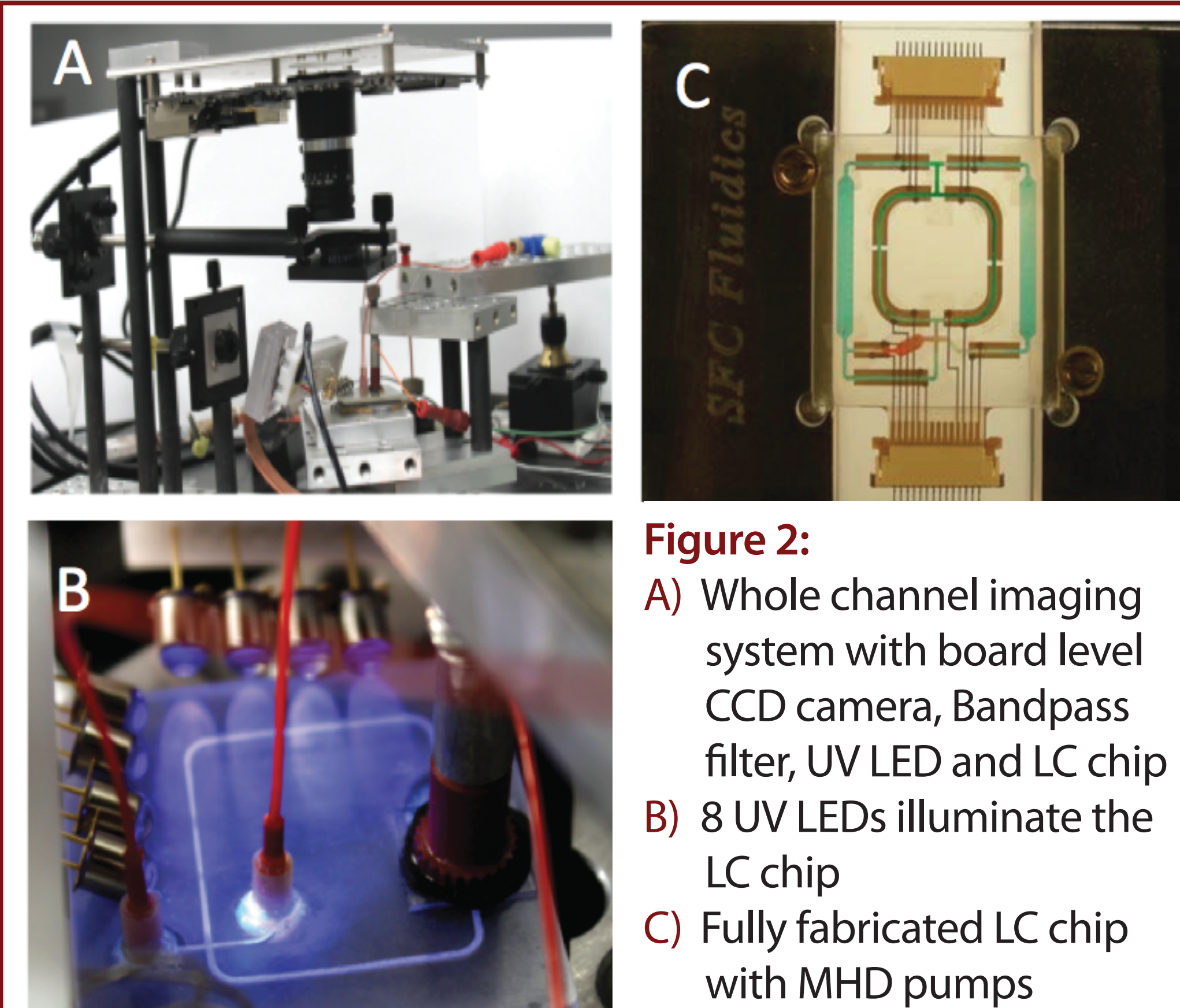
## PUMP CHARACTERIZATION

- Redox species: Potassium ferri/ferro cyanide
- Magnetic field : 0.25-0.6 T
- Channel dimension: 0.02" sq-0.03" sq.
- Max. speed achieved: 5 cm/min



**Figure 1:** Measurement setup for parametric study in test tracks (top). Measured linear velocity vs. lumped theoretical parameter. Data includes range of channel width, height, current, magnetic field and number of pumps activated

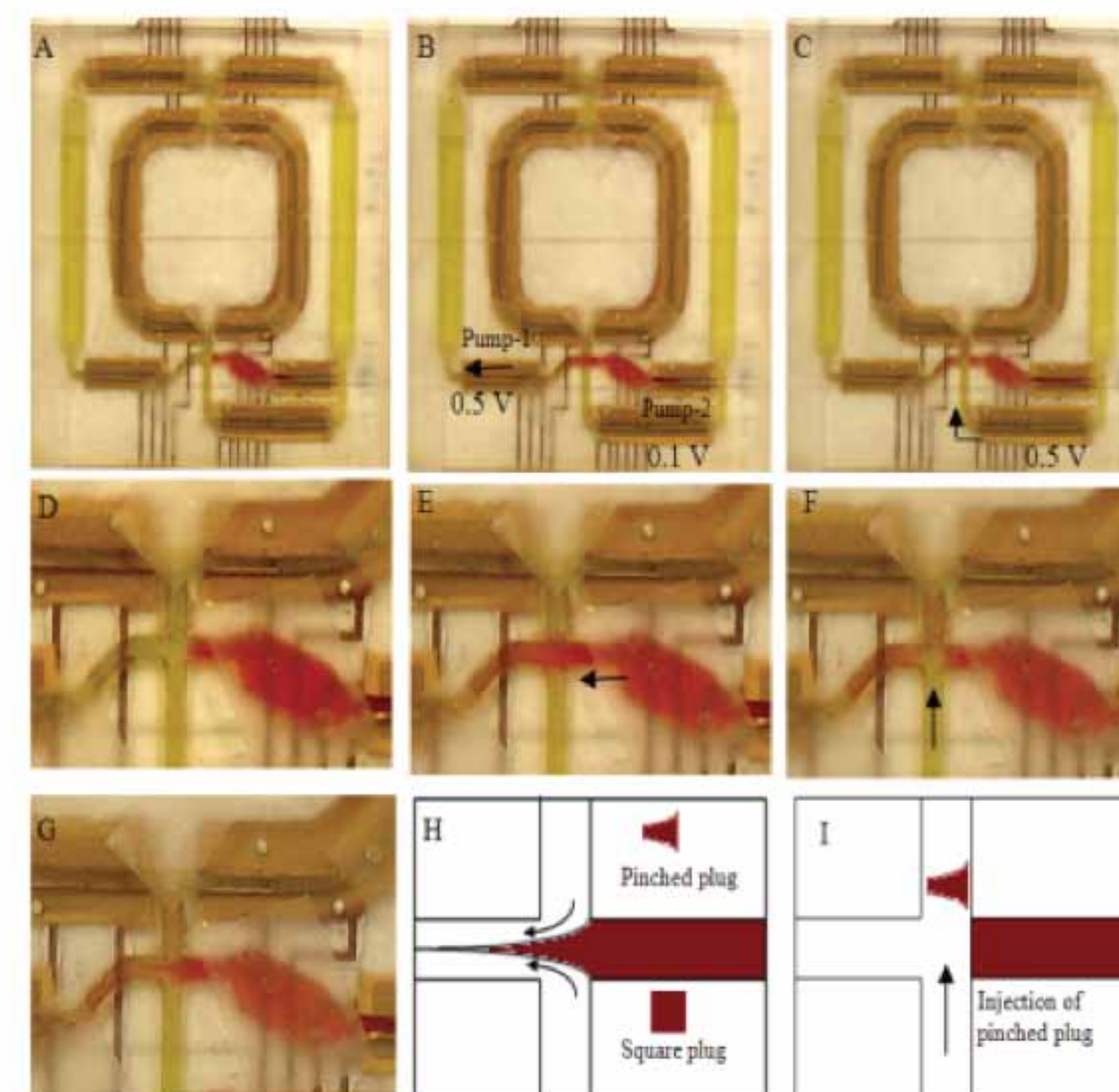
## DETECTION



**Figure 2:**

- Whole channel imaging by CCD camera (Hamamatsu C10990-904)
- UV LED (NICHIA, 365+/-5nm) as light source, 5mm dia, 1000 uW
- Band pass filter before the camera

## SAMPLE INJECTION in CLOSED LOOP

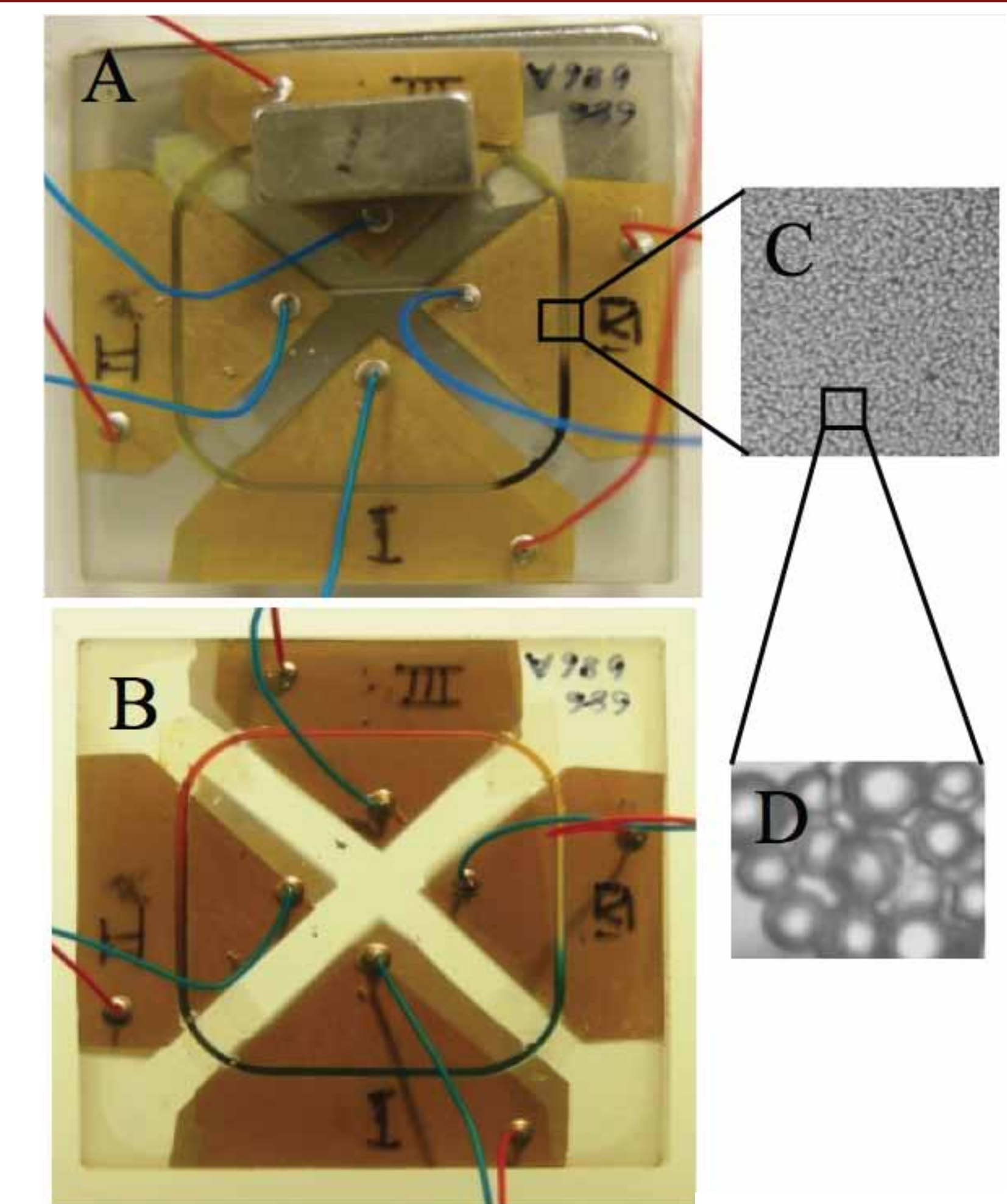


**Figure 3:** Different stages of sample injection on polycarbonate chip. It is possible to control the shape of plug injected, by properly controlling the MHD pumps.

## CHIP FABRICATION

- Chip material : Polycarbonate, COC, COP
- Electroless/ thermally evaporated gold deposition
- Channel cut by CNC m/c
- Thermal bonding
- MHD pumps tested with cyclic voltammetry

## FOOD DYE SEPARATION



**Figure 4:** Preliminary food dye separation using packed circular LC using in situ MHD pumping. (A) initial condition, (B) final separation, (C) packing structure (100x), (D) packing material (430x).

- FD&C Red 40, Blue 1
- Packed bed : Silica particles, 15 um
- Mobile phase: Methanol: water :: 5:95
- Pumps : 2 MHD pumps @ 0.2 V
- Magnetic field: 0.65 T, NdFeB magnets
- Time taken: 40 minutes

## Conclusion

- Demonstration of cyclic LC-on-chip
- Limited scope in LC due to inadequate pumping speed
- Can be used in other closed loop application