Georgia Tech Chemical & Biomolecular Engineering

INCORPORATING FLOW CONTROL FUNCTIONALITY IN MICROFLUIDIC PAPER-BASED ANALYTICAL DEVICES USING PLASMA PROCESS

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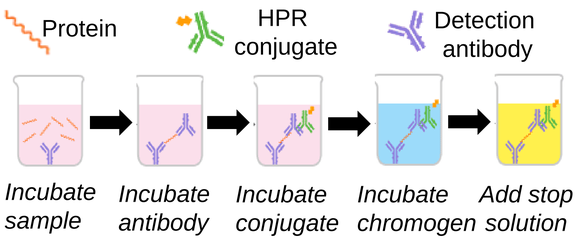
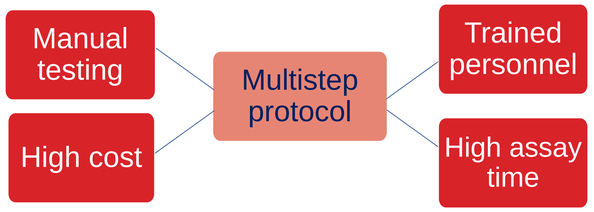
BACKGROUND



Enzyme-linked immunosorbent assay for non-infectious and infectious diseases detection

PROBLEM STATEMENT



Multistep protocol of immunoassays requires automated diagnostics device in remote areas

RESULTS

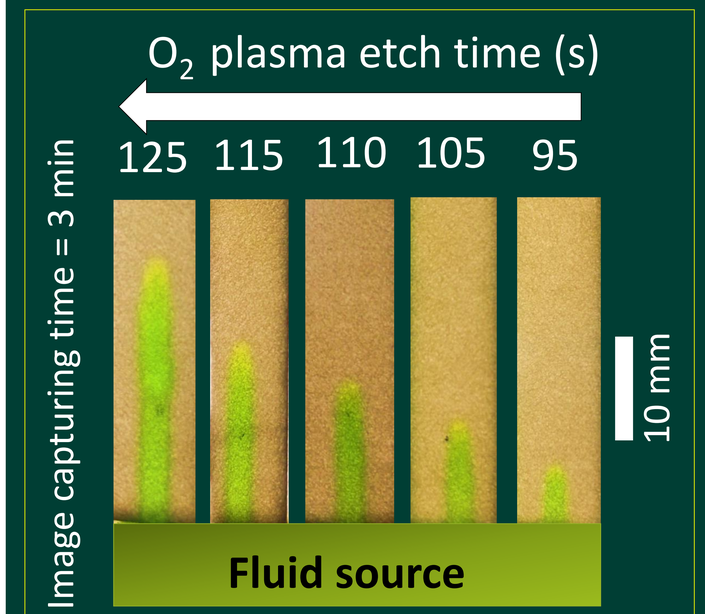
- **Fully enclosed microfluidic paper-based analytical devices** fabricated by fluorocarbon (pentafluoroethane (PFE)) plasma deposition followed by O_2 plasma etching.
- Flow channels with **different wettability** can be formed by varying O_2 plasma etch time
- Flow channels protected by hydrophobized paper layers to **inhibit contamination**
- Channels sealed with adhesive tape to prevent **sample evaporation**
- Device operation demonstrated by three reagents with different pH values **sequentially reacting** with indicator at detection zone

CONCLUSION

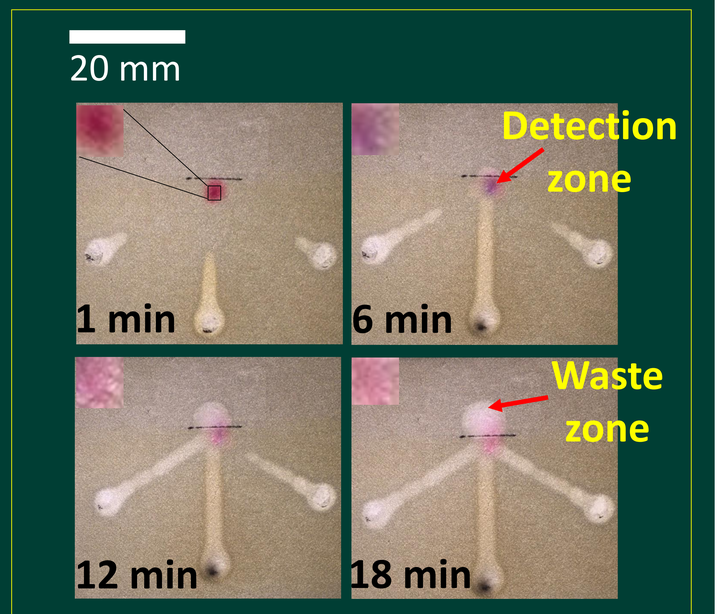
- Proposed µ-PADs make possible automated multistep protocol assays (e.g. ELISA) to be employed for low-cost disease diagnostics in remote locations
- Fully enclose channels can be easily packaged using adhesive tape to eliminate need for device packaging, thus decreasing overall device cost

REFERENCES

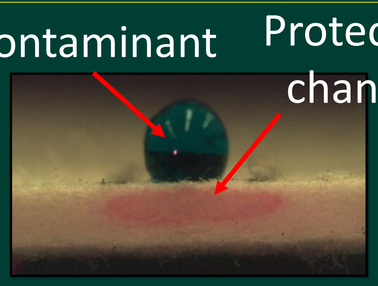
1. https://www.cusabio.com/c-15109.html
2. Raj et al., Sensors and Actuators B: Chemical, 2020
3. Raj et al., Lab on a Chip, 2019



Channels with varying wettability



Sequential addition of reagents at detection zone

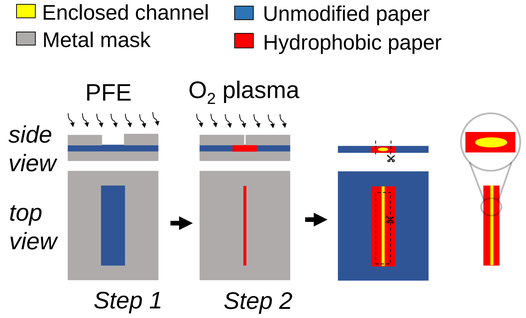


Cross–sectional image

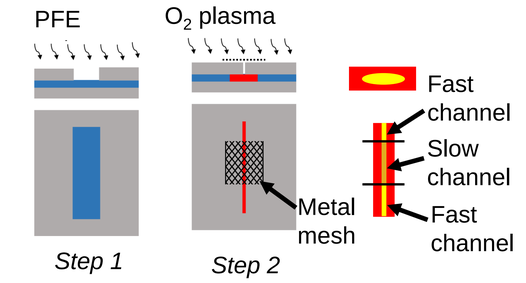
Fully enclosed channels for inhibition of contamination and evaporation

Take home: The proposed paper-based device design can **automate** multistep protocol assays thereby making diagnostic tests such as **ELISA** a viable option for **low-cost** disease diagnostics in remote areas

FABRICATION METHOD

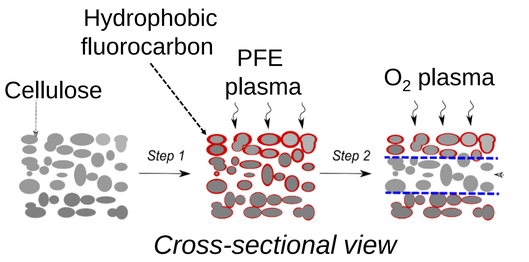


Two-step process to fabricate fully enclosed channels with varying wettability



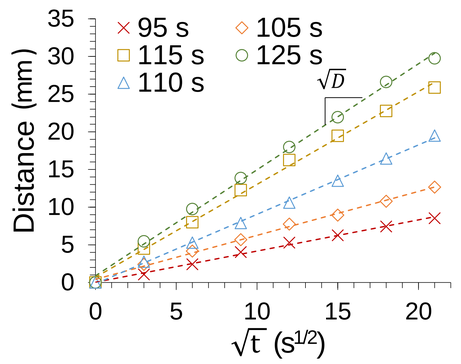
Fabrication of channels with different wettability in single O_2 plasma step using metal mesh

EXPLANATION



Cross-sectional view

Physics of channel making



Quantification of wicking speed using Washburn equation