# Porous Silicon on Glass for Low-Cost Diagnostics

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## Background

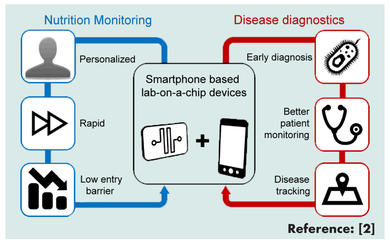
**Current System of Diagnostic Testing:**
*Chips-In-A-Lab*

- Use large and expensive equipment
- Samples usually processed far from the patient
- Difficult to track down patient for treatment in rural areas

**Characteristics of the ideal diagnostic test — ASSURED**

- **Affordable** by those at risk of infection.
- **Sensitive** (few false-negatives).
- **Specific** (few false-positives).
- **User-friendly** (simple to perform and requiring minimal training).
- **Rapid** (to enable treatment at first visit) **and Robust** (does not require refrigerated storage).
- **Equipment-free**.
- **Delivered** to those who need it.

Reference: [1]



Reference: [2]

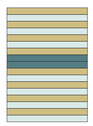
**New System:**
*Lab-On-A-Chip*

- Cost-effective, fast, and portable
- Use a smartphone for the computing, user interface, and sensing

## Materials

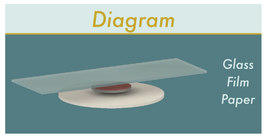
**Porous Silicon (PSi) Film**

- *Microcavity filter:* thickness 1.5 - 3 μm
- *Pore diameter:* 20 - 30 nm
- *Fabrication:* electrochemical etch and liftoff followed by chemical oxidation
- Large surface area ≈ 100 $m^2/cm^3$
- Easy surface modification



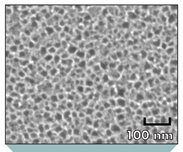

**Glass**

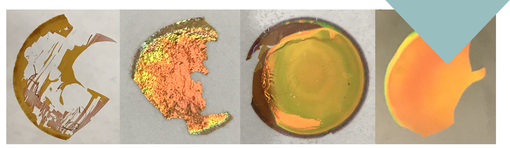
- Enables robust platform




**Paper**

- Filter paper
  - Facilitates molecule transportations
  - Blocks undesired molecules
- Blotting paper
  - Works as a pump to draw liquid across filter paper



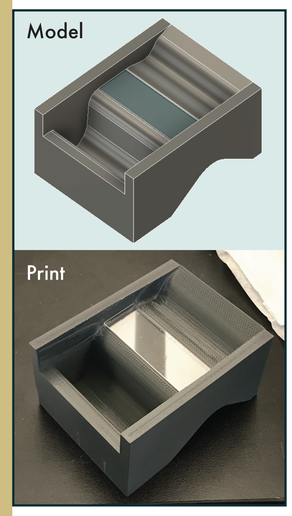



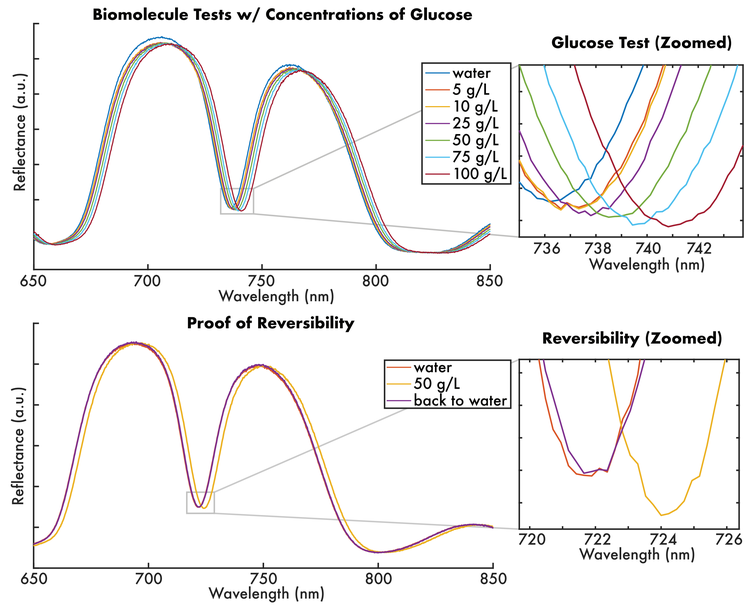
*Progression of Film Quality though Fabrication Process*

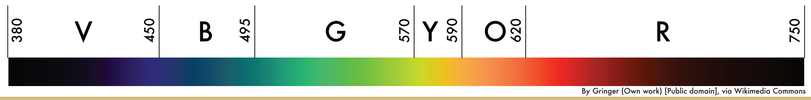
## Testing With Biomolecules

- Measure reflectance spectra using Ocean Optics® spectrometer
- Reflectance spectrum red-shifts when analyte infiltrates into the pores
- Magnitude of shift quantifies the molecules added

**Flow Cell**



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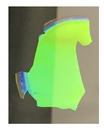
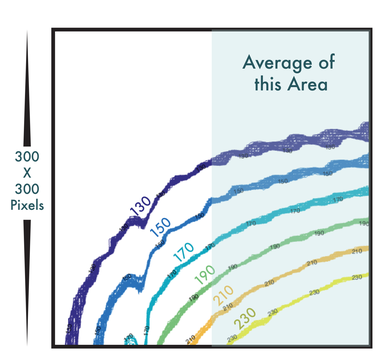
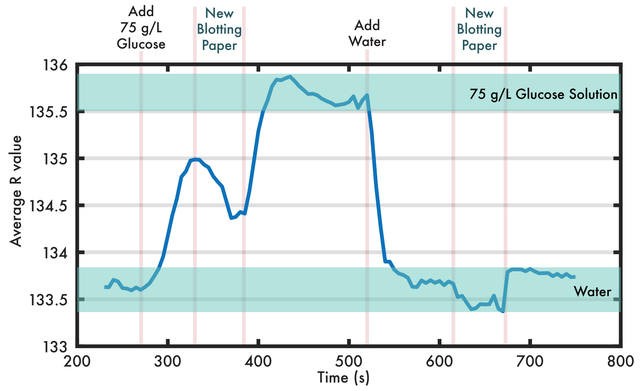
## Sensing with Smartphone Camera

- Use smartphone to take videos of the sample
- Film color changes when analyte infiltrates into the pores
- Magnitude of change in light intensity at the red channel (R value) quantifies the molecules added
- Film spectrum shifts from around 500 nm (green) to 600 nm (red-orange) when wet.





Contour map of R values obtained from video of PSi film during experiment

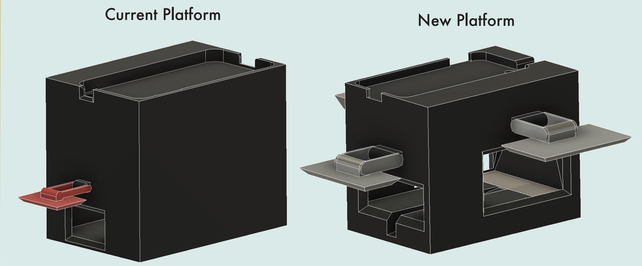



## Conclusion

- Successfully lifted porous silicon thin film off silicon wafer and transferred onto glass slide without compromising optical properties
- Built a robust PSi sensing platform
- Measured change in porous silicon thin film refractive index due to infiltration with glucose using both a spectrometer and a smartphone camera

## Future Work

- Correlate spectral shift to smartphone readings
- Test new platform designs to reduce inherent error due to motion




## References

[1] Mabey, David, et al. "Diagnostics for the developing world." Nature reviews. Microbiology 2.3 (2004): 231.

[2] Erickson, David, et al. "Smartphone technology can be transformative to the deployment of lab-on-chip diagnostics." Lab on a Chip 14.17 (2014): 3159-3164.

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## Acknowledgments

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