

Utilizing Spectroelectrochemical Detection to Improve the Sensitivity of the Shear Enhanced Lab on a Chip Device

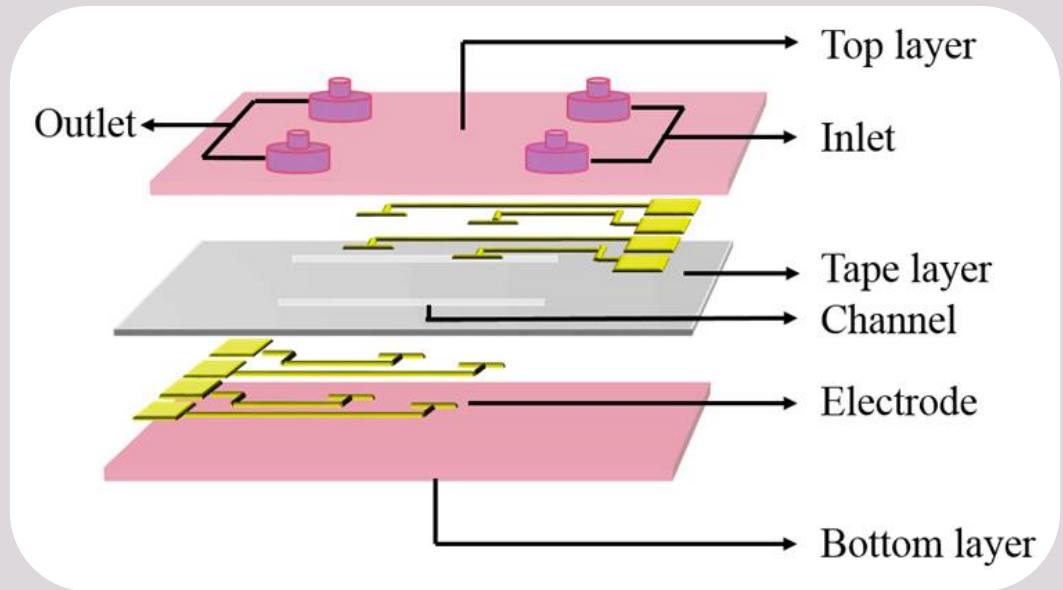
Shweta Burgula

The background features several overlapping circles of varying sizes and shades of light gray, creating a layered, depth effect. The largest circle is centered and contains the text. Other circles are positioned around it, some overlapping its edges, and some smaller circles are clustered in the bottom-left corner.

Consider this
Scenario

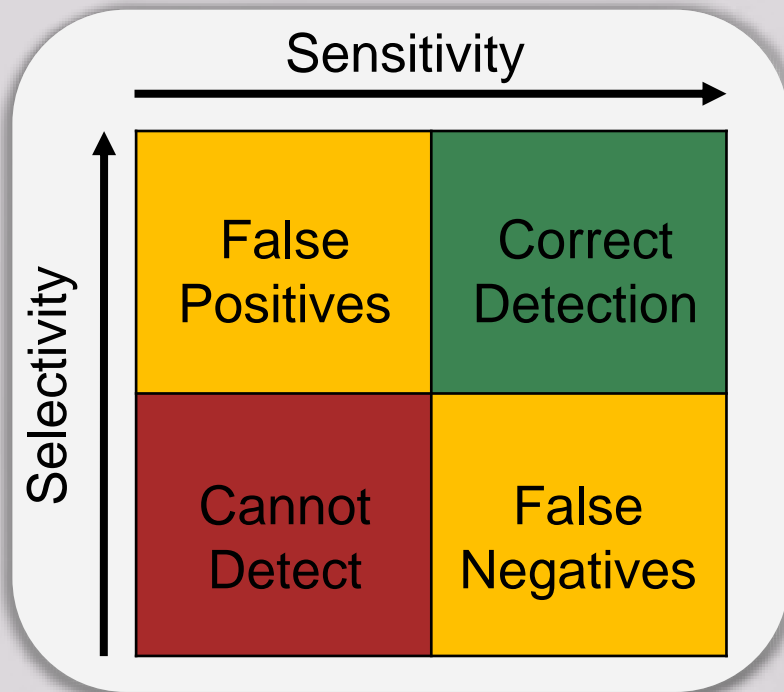
The Lab on a Chip

Detect molecular indicators of disease called biomarkers



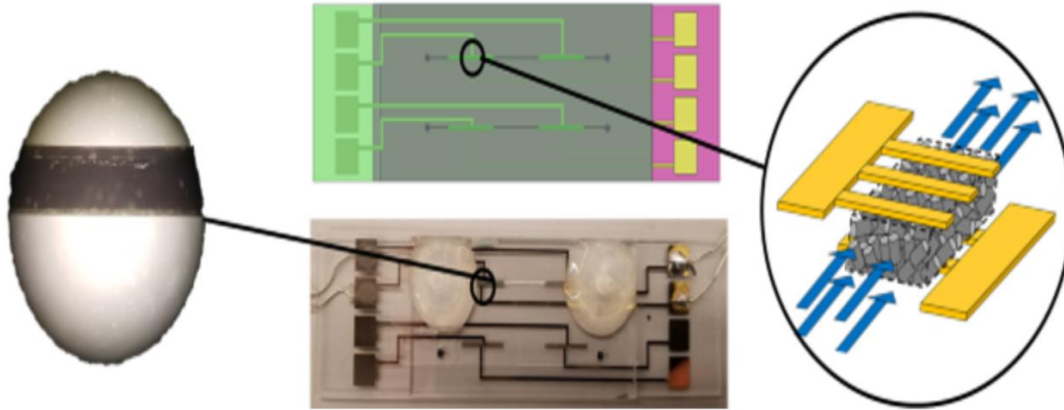
Qualities of Good Testing

- **Sensitivity:**
Detecting all of the molecules present in the sample.
- **Selectivity:**
Differentiating between different molecules



Shear Enhanced Lab on a Chip

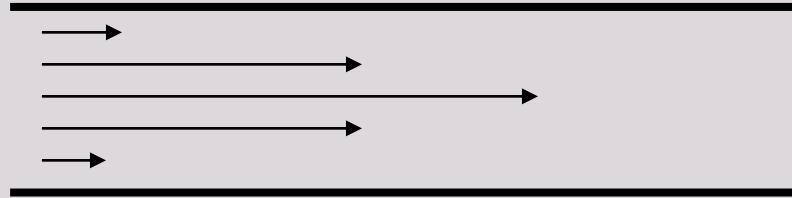
The addition of CNT greatly enhances accuracy.



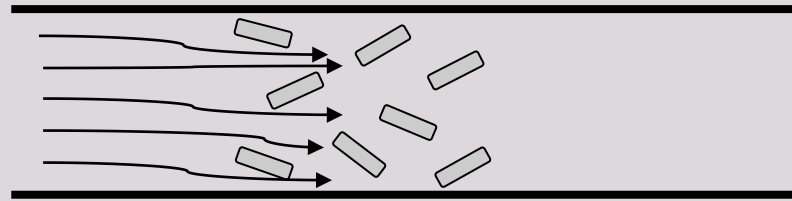
Cheng 2019

Sensitivity and Selectivity in the Shear Enhanced Chip

Laminar Flow



Turbulent Flow



Modifying for Optical Detection

01

Strong optical
properties

02

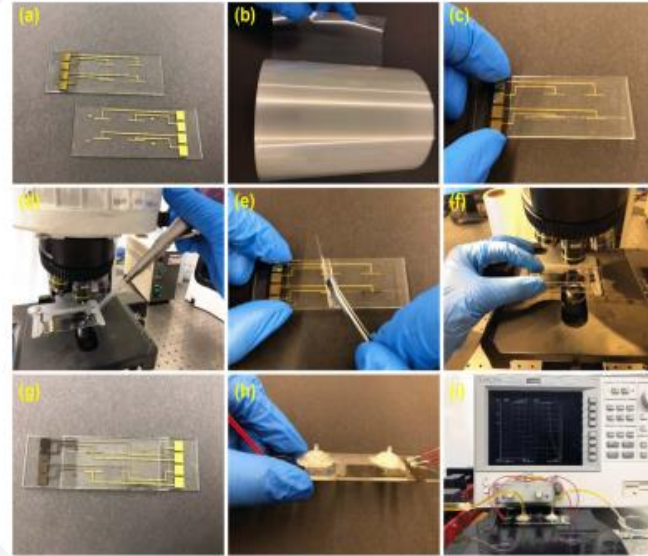
Retain electrical
response

03

Strong optical
properties

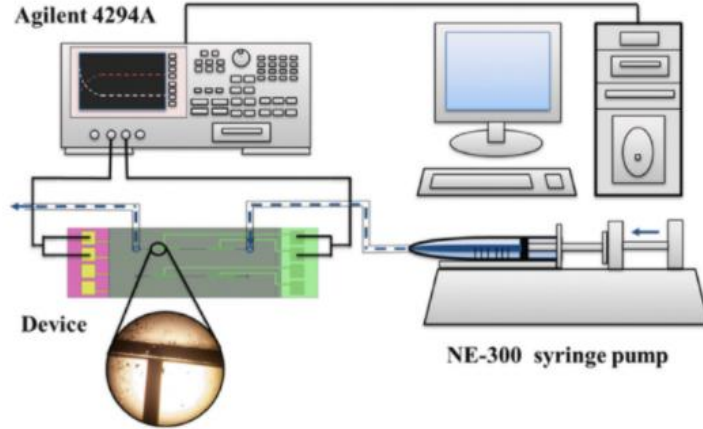
Assembling the Chip

- Redesigned the chip
- Replaced CNT with ReS_2
- Find appropriate packing density



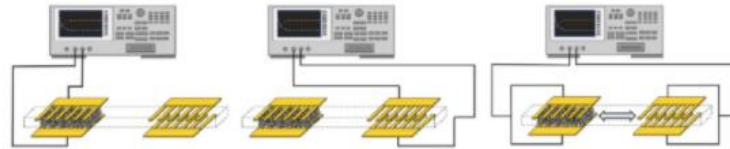
Li 2019

Testing the Chip



Different Electrode Configurations

- (A) Material electrode ME
(B) Clear electrode CE
(C) Working Electrode WE



Testing the Chip

7

Concentrations
of KCl

5

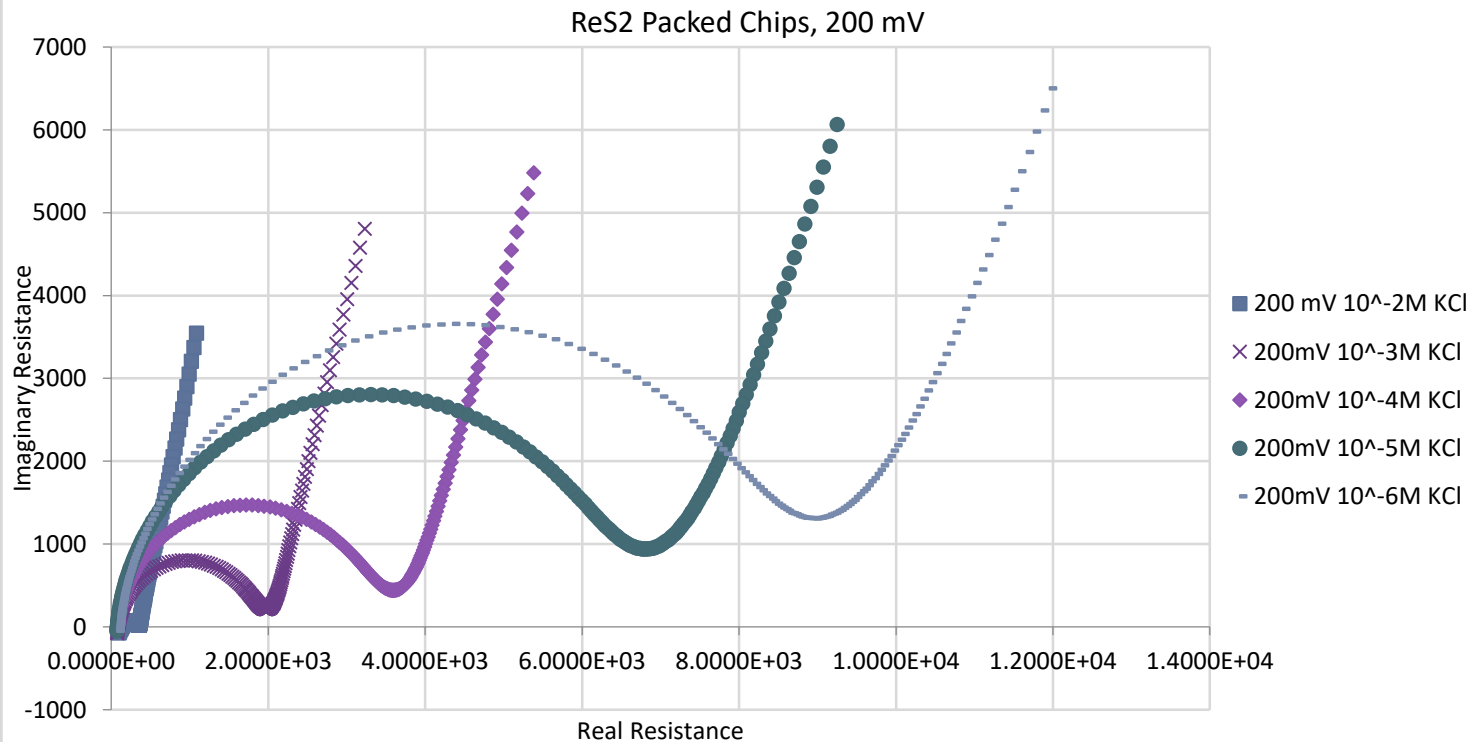
Voltages,
100-500mV

3

Configurations
in the machine

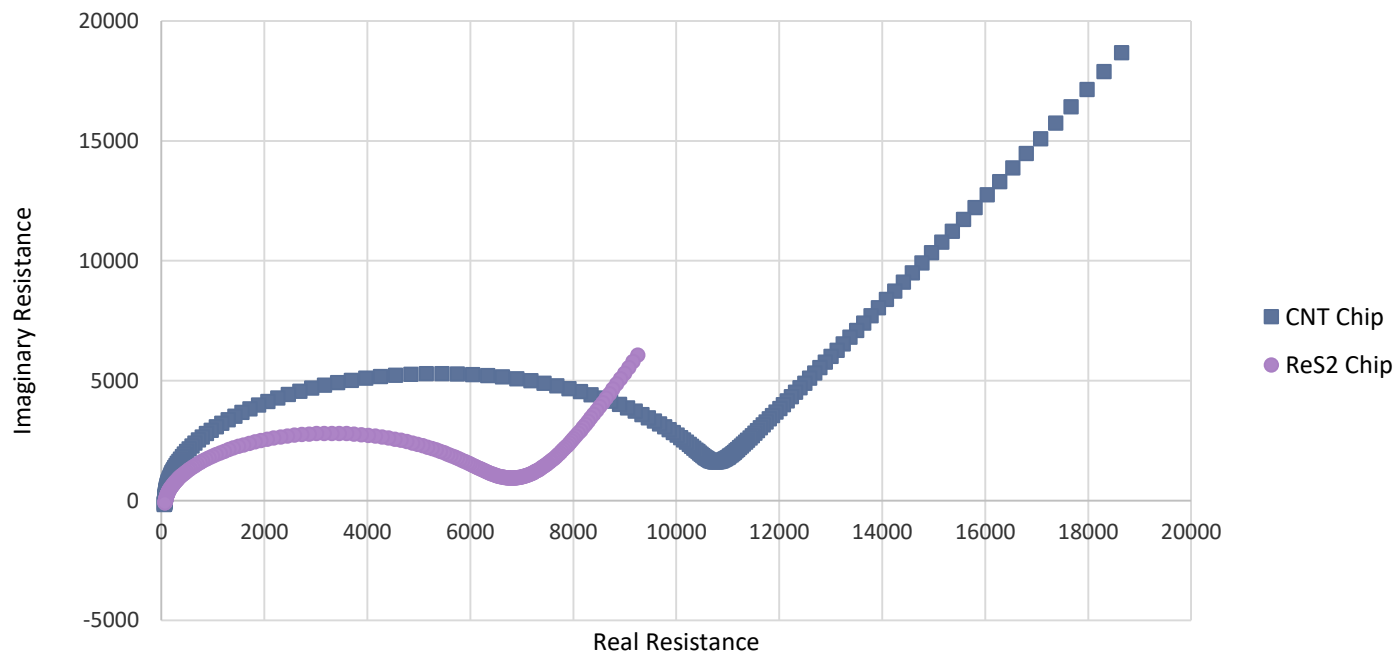
105
Runs

Results



Results

KCl 10^{-4} M, 200 mV



Future Works

- Repeat the experiment without light
- Functionalize ReS₂
- Analyze optical absorbance and electrical resistance after functionalizing

Conclusions

- Current lab on a chip devices are lacking in high selectivity and sensitivity
- Adding a secondary method of testing can improve sensitivity
- ReS_2 is a ideal due to its versatile optical properties and ability to act as a dielectric

Acknowledgements

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This work was done at NJIT under the guidance of Zhenglong Li and Dr. Sagnik Basuray.

References

- Zhenglong Li, Yu-Hsuan Cheng, Lixin Feng, and Sagnik Basuray et al. "Electrochemical Impedance Signature of a Non-planar, Interdigitated, Flow-through, Porous, Carbon-based Microelectrode". *Journal of the Electrochemical Society* 166 (2019): B1669-B1672.
- Yu-Hsuan Cheng, Reis Moura Pedro Antonio, Li Zhenglong, and Sagnik Basuray et al. "Effect of electrode configuration on the sensitivity of nucleic acid detection in a non-planar, flow-through, porous interdigitated electrode". *Biomicrofluidics* 13, no. 6 (2019): 064118.

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