Using Machine Learning with Porous Silicon to Determine IgG Concentrations in Human Serum

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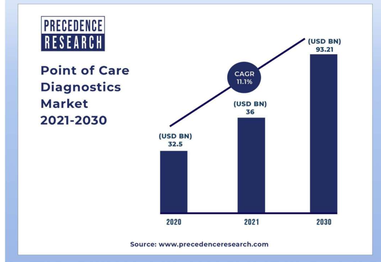
Introduction



Current Disadvantages of Protein Detection in Serum	
Slow	Requires Trained Personnel
Bulky Equipment	Expensive

[1]

Advantages of Porous Silicon	
Fast	Robust
Small	Cheap

[2]

Irregular Immunoglobulin G (IgG) Levels → Immunodeficiency Diseases → Rheumatoid Arthritis[3], Pneumonia[4]

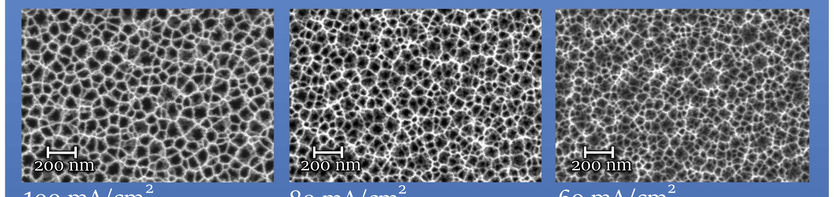
Goal

Using multiple porous silicon biosensors and machine learning to develop a point-of-care device which accurately identifies unhealthy IgG concentrations in serum

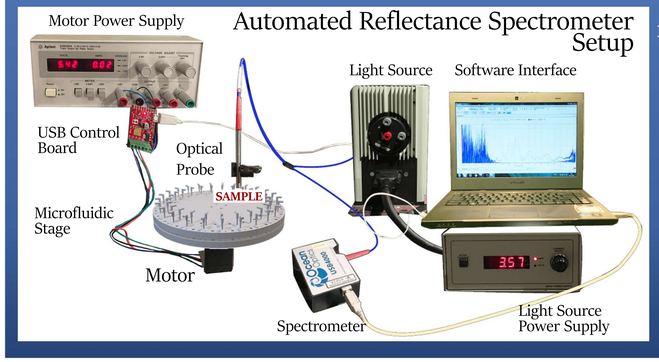
Materials and Methods

Tuning formation conditions of porous silicon provides control over average pore size and enables size-selective filtering of molecules

Decreasing average pore diameter →

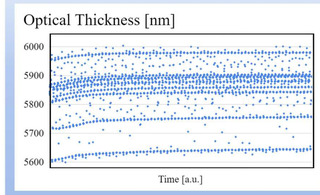


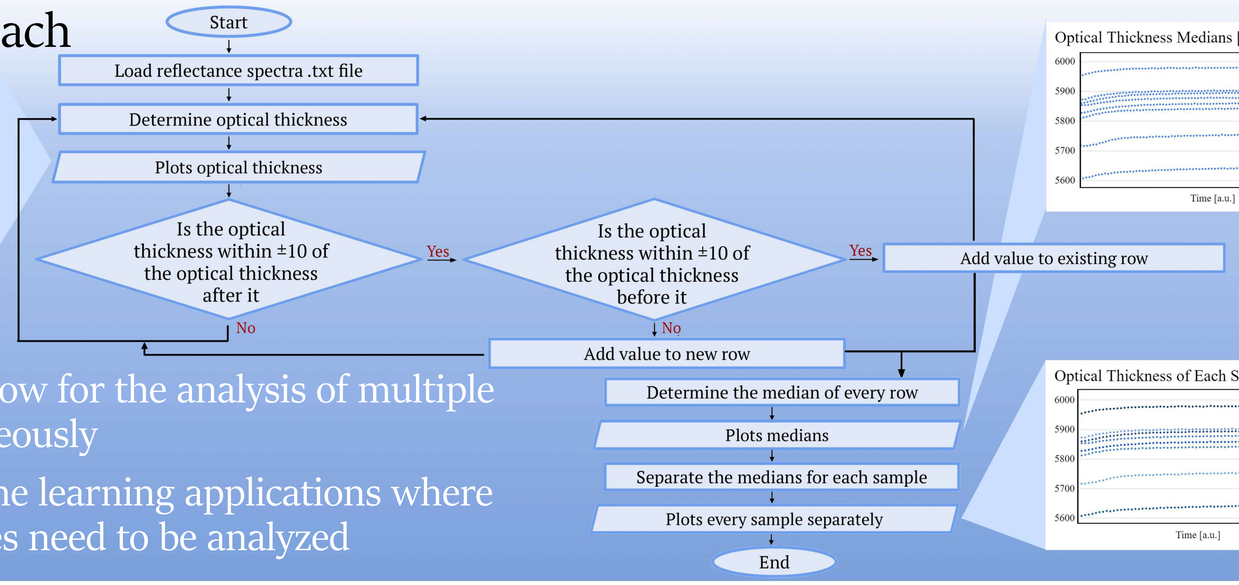
100 mA/cm^2 80 mA/cm^2 60 mA/cm^2



molecules enter the pores → change in the optical thickness → red shift in the reflectance spectrum

Analysis Approach

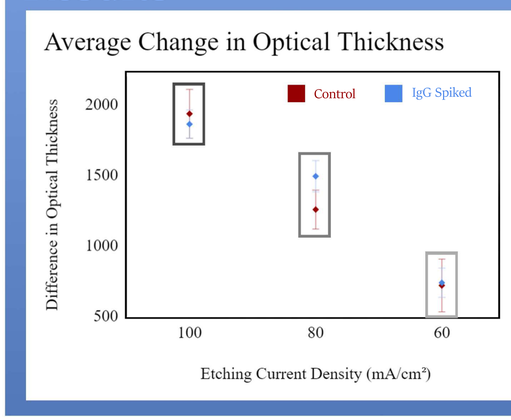


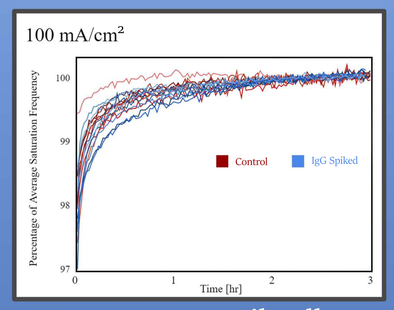


Python code to allow for the analysis of multiple samples simultaneously

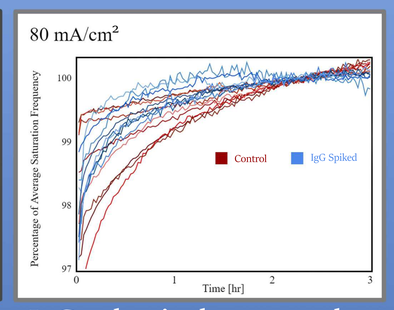
Critical for machine learning applications where millions of samples need to be analyzed

Results

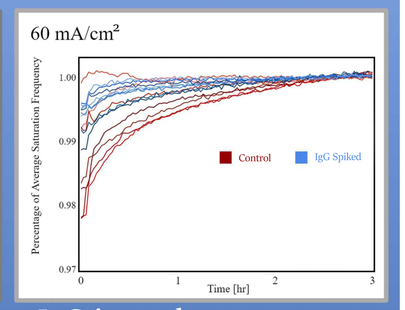




Large pores easily allow both IgG and serum proteins to enter the pores and saturate the surface



IgG selectively enters the pores, changing the optical thickness at a different rate than the control serum



IgG is too large to enter small pores so there is minimal change in the optical thickness

Conclusions and Future Directions

Controlling average pore size of porous silicon enables discrimination of IgG spiked serum

Etching Current	Solvent pH	Hydrophobicity
80 mA/cm^2	?	?

Train a machine learning algorithim to determine if IgG concentration is irregular

→ at home testing
→ in-office testing

Acknowledgements

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