Low-level Glucose Detection by Microgap Arrays

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Introduction

In this work, the detection of low Glucose concentration is discussed. A patient-friendly technology that does not require a needle stick or venipuncture. To provide accurate, low cost and continuous glucose monitoring. Each micro-gap is formed by bridging a pair of gold electrodes (Au) on an oxidized Si substrate using Optical lithography separated with a small gap of 4-6 microns.

Microgap glucose sensor design

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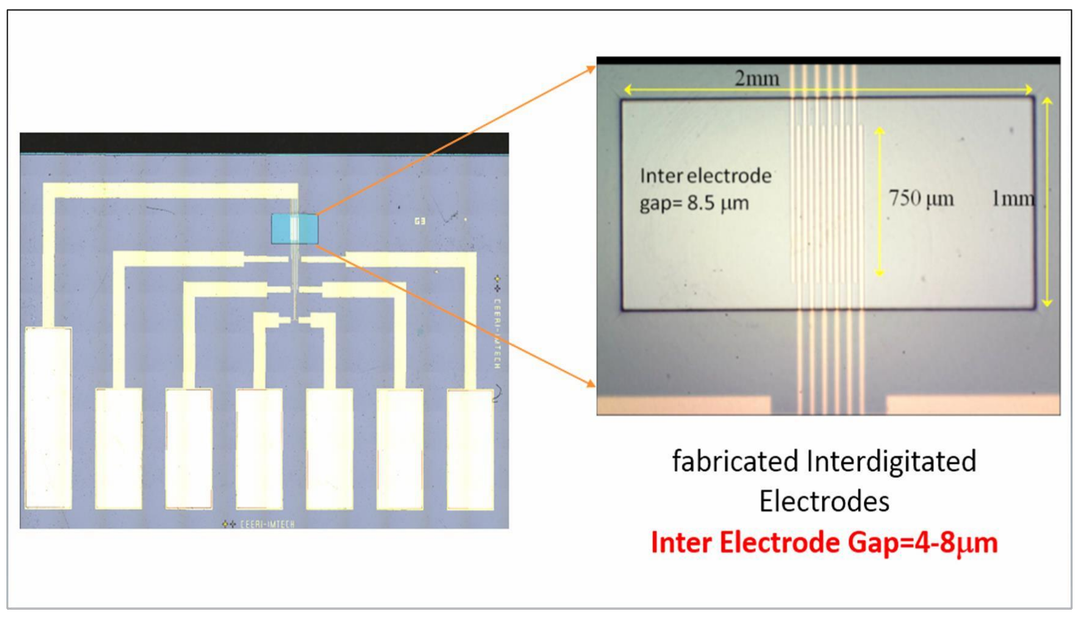
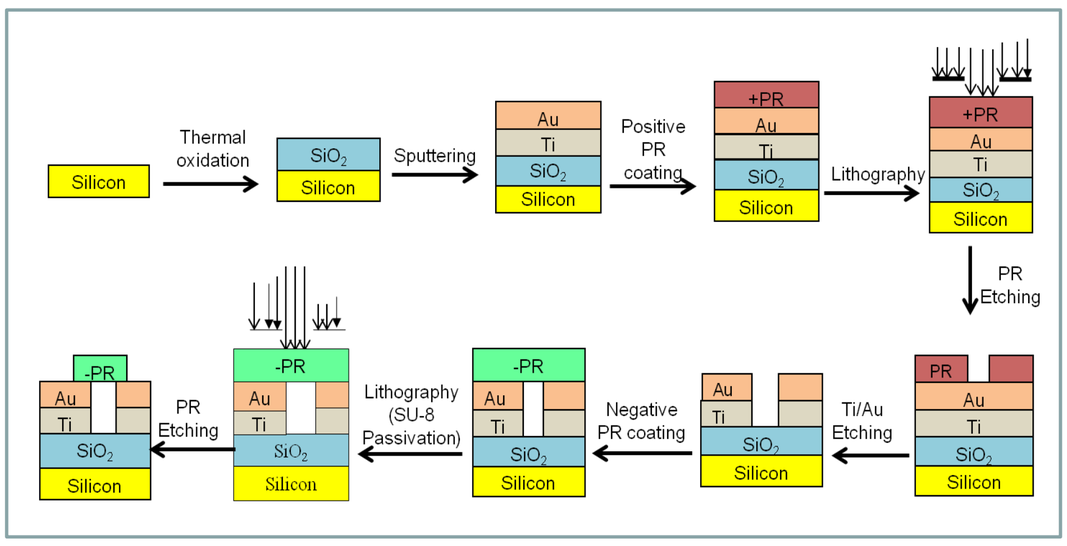


fabricated Interdigitated Electrodes

Inter Electrode Gap=4-8µm

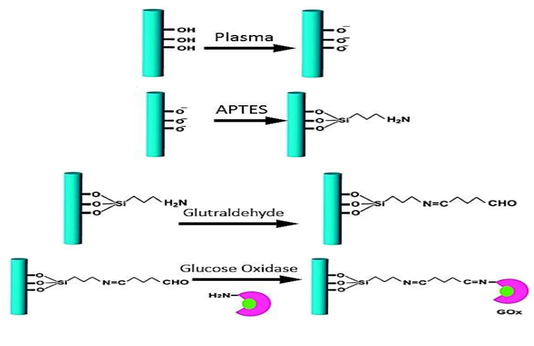
Fabrication procedure



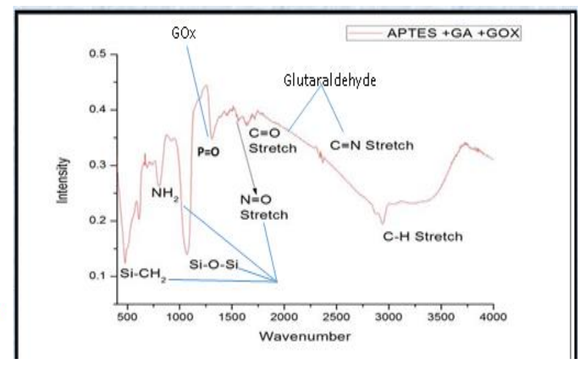
- Electrode Array structures were fabricated on a 4” silicon wafer.
- First the wafer was cleaned and oxidized thermally to grow a 1 µm silicon dioxide layer.
- Ti-Gold thin film (0.2 um) was sputtered on the wafers.
- Photolithography was carried out to pattern the electrodes on the wafer.
- Unwanted gold-Ti was removed used gold/titanium etchants.
- Then 30-35 µm thick layer negative photoresist (SU-8) was spin-coated, followed by second photolithography for device passivation and a 1 mm x 2 mm window was opened.

Results

Surface modification & immobilization on SiO_2 surface



GOx immobilization steps

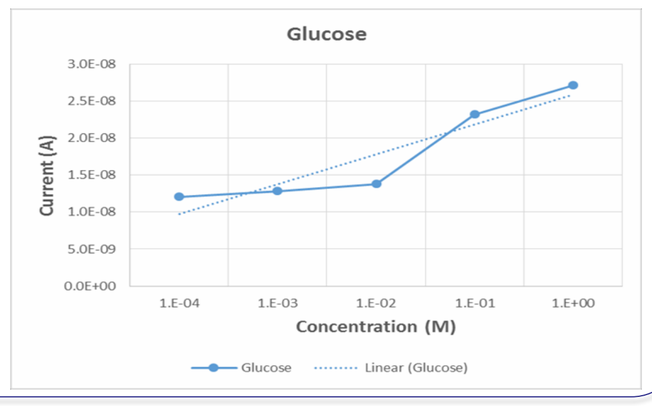


FTIR spectra of GOx modified surface

Glucose detection

➢ **Bipolar pulse measurements** were conducted to detect different concentrations of glucose(0.1mM to 1M) in PBS.

Concentration(M)	Conductance (nS)
10^{-4}	12.074
10^{-3}	12.861
10^{-2}	13.799
10^{-1}	31.720
1	40.842



Conclusions

- A microelectrode biosensor with an electrode gap of 4-8 µm is fabricated for the non-invasive determination of low glucose concentrations.
- The fabricated device has dimensions as an area of electrodes is 360µm ×750µm, the width of one electrode is 28µ, the window is 2×1mm^2 and the contact pad is 2×4 mm^2.
- Bipolar pulse measurements were conducted to detect glucose of different concentrations in DI water. The current response increased with the elevation of glucose concentration and tended to reach a saturation value where all active sites of GOx were used up.

References

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Acknowledgments

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