Disposable Glucose Nanosensor

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I. Introduction

Diabetes has been a rapidly growing problem worldwide. In order to minimize the negative effects of the disease, it is critical to monitor and control blood sugar levels at an individual basis. Our project was developed to create a disposable nanosensor using Anodic Aluminum Oxide (AAO) that is able to detect a wide range of glucose concentrations.

II. Fabrication of Anodic Aluminum Oxide(AAO)

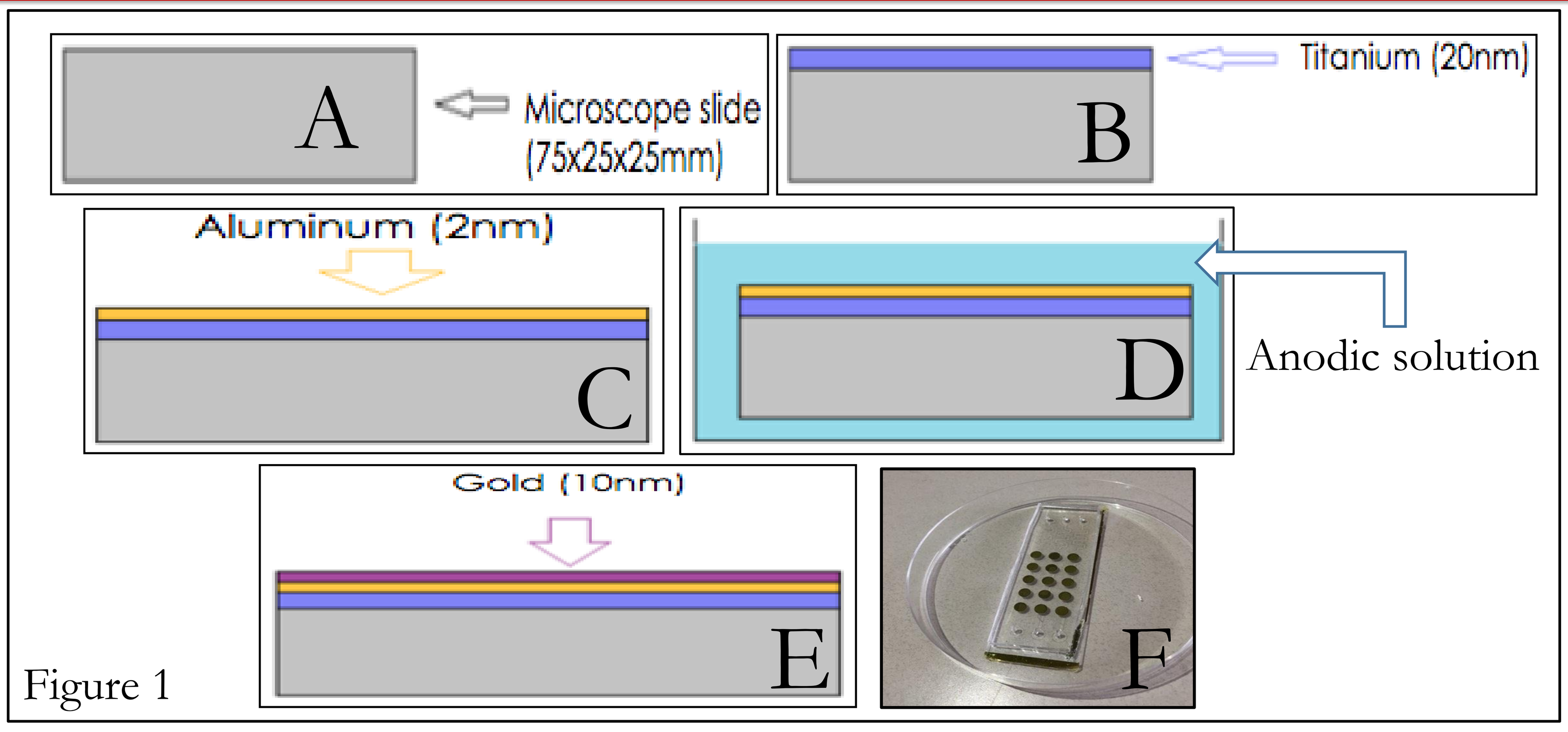

Figure 1

Figure 1A Start with Fisherfinest Premium Clipped Corner microscope slides
Figure 1B Deposit 20nm of titanium on the glass using electron beam (E-beam) evaporation
Figure 1C Deposit 2nm of aluminum using E-beam evaporation
Figure 1D Submerge in acidic solution to anodize the aluminum
Figure 1E Used sputtering process to deposit a thin layer of gold
Figure 1F Completed samples

III. Operating System

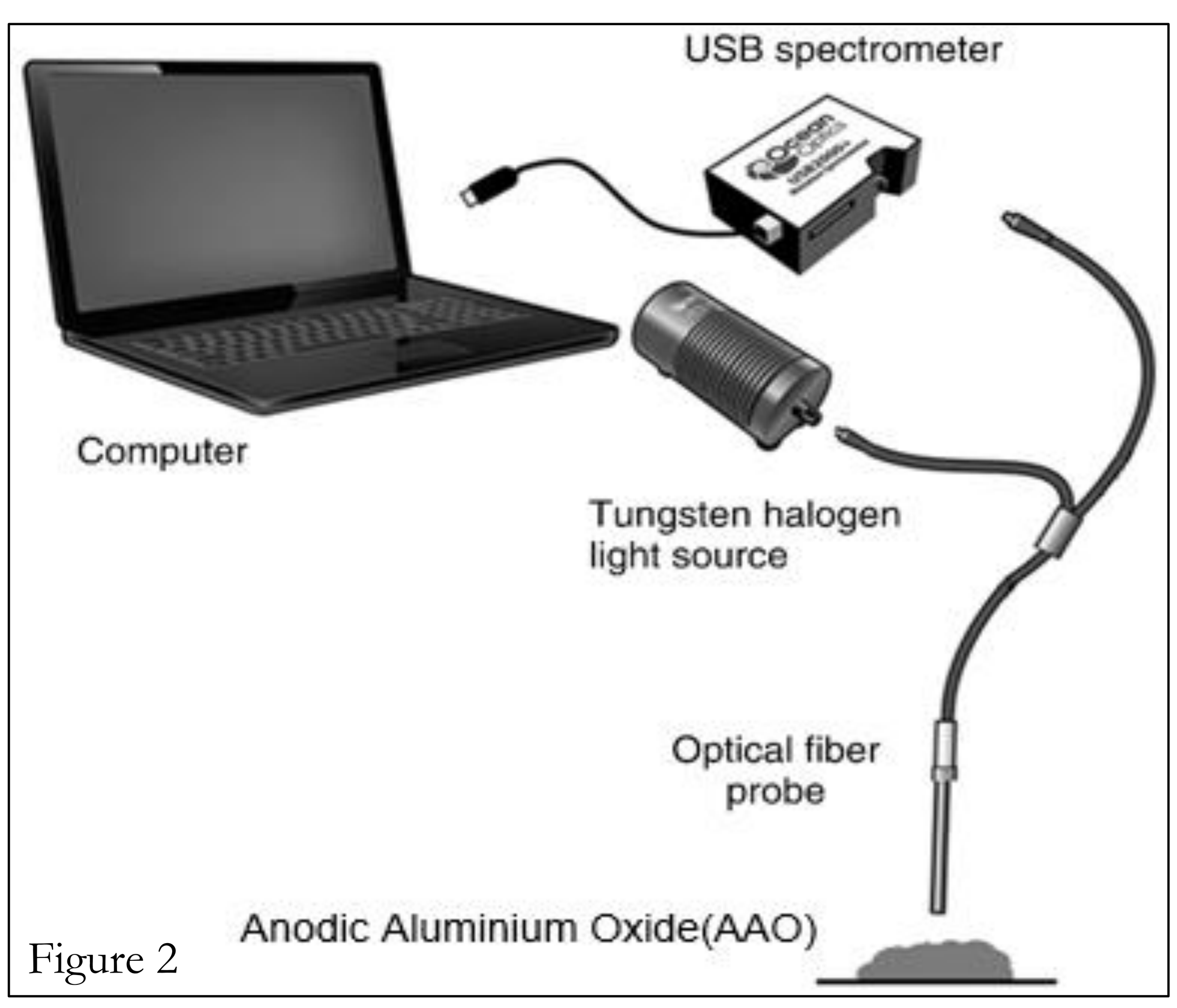

Figure 2

Procedure:

1. Measure the AAO without any solution present
2. Obtain a wavelength vs intensity graph using OceanView software
3. Deposit a fixed amount of glucose solution onto the surface of AAO using a precision pipette
4. Place the AAO on a hot plate of 80°C to speed up the evaporation process
5. After completing the evaporation, place the AAO under the fiber probe to obtain a wavelength vs intensity graph
6. Repeat steps 3 to 5 two more times with exactly the same amount of glucose solution

IV. SEM Image of AAO Coating

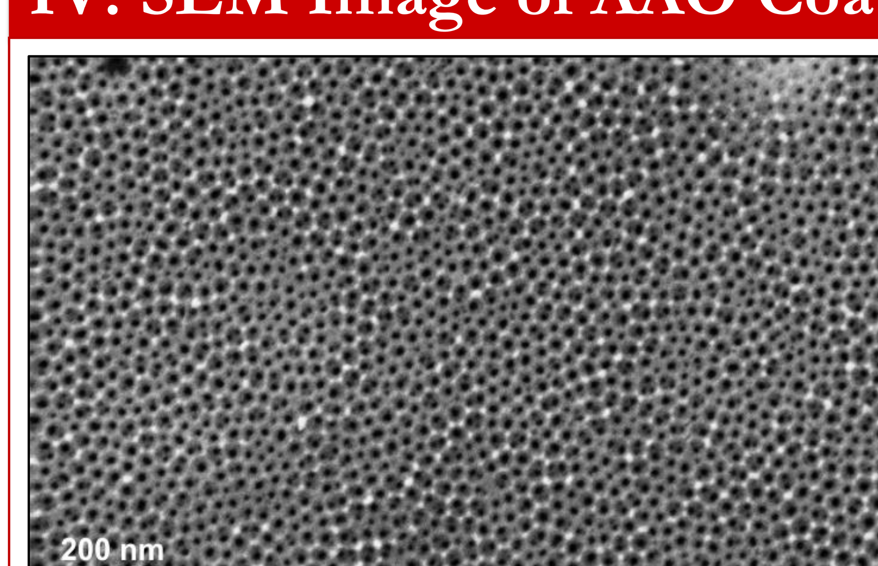

Figure 3 SEM image of the Anodic Aluminium Oxide obtained in an acidic solution

- The process of creating AAO-metal can utilize an inexpensive and simple method of electrochemical metal deposition
- This electrochemically obtained porous layer of AAO is used as a sensor to detect glucose optically

V. Function of Nanopores

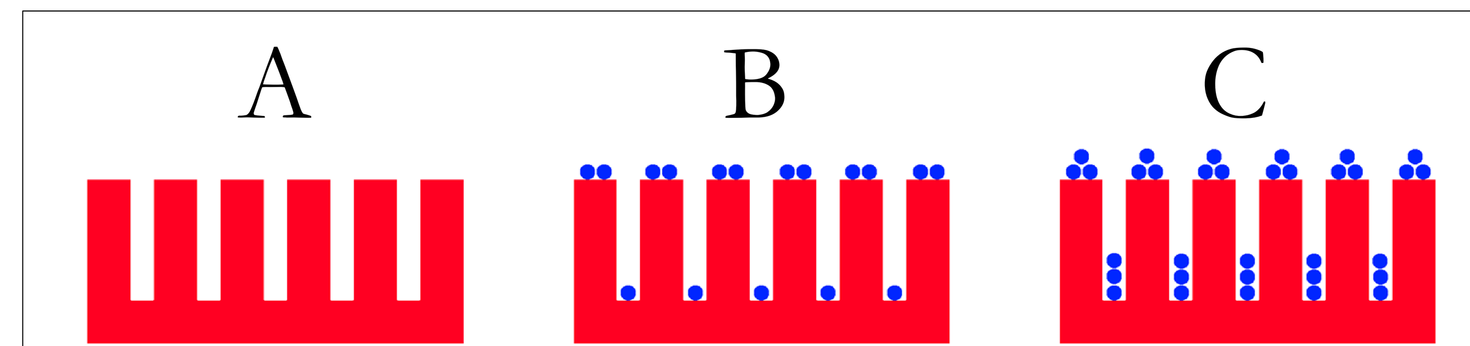

Figure 4

Figure 4A shows the nanopore structure before any glucose is deposited
Figure 4B shows the nanopore with a small amount of glucose
Figure 4C shows the structure with a high concentration of glucose

VI. Results of Different Glucose Concentrations

Below are the shifts in wavelength by combining all data sets from a single AAO sample at different applied concentrations of glucose

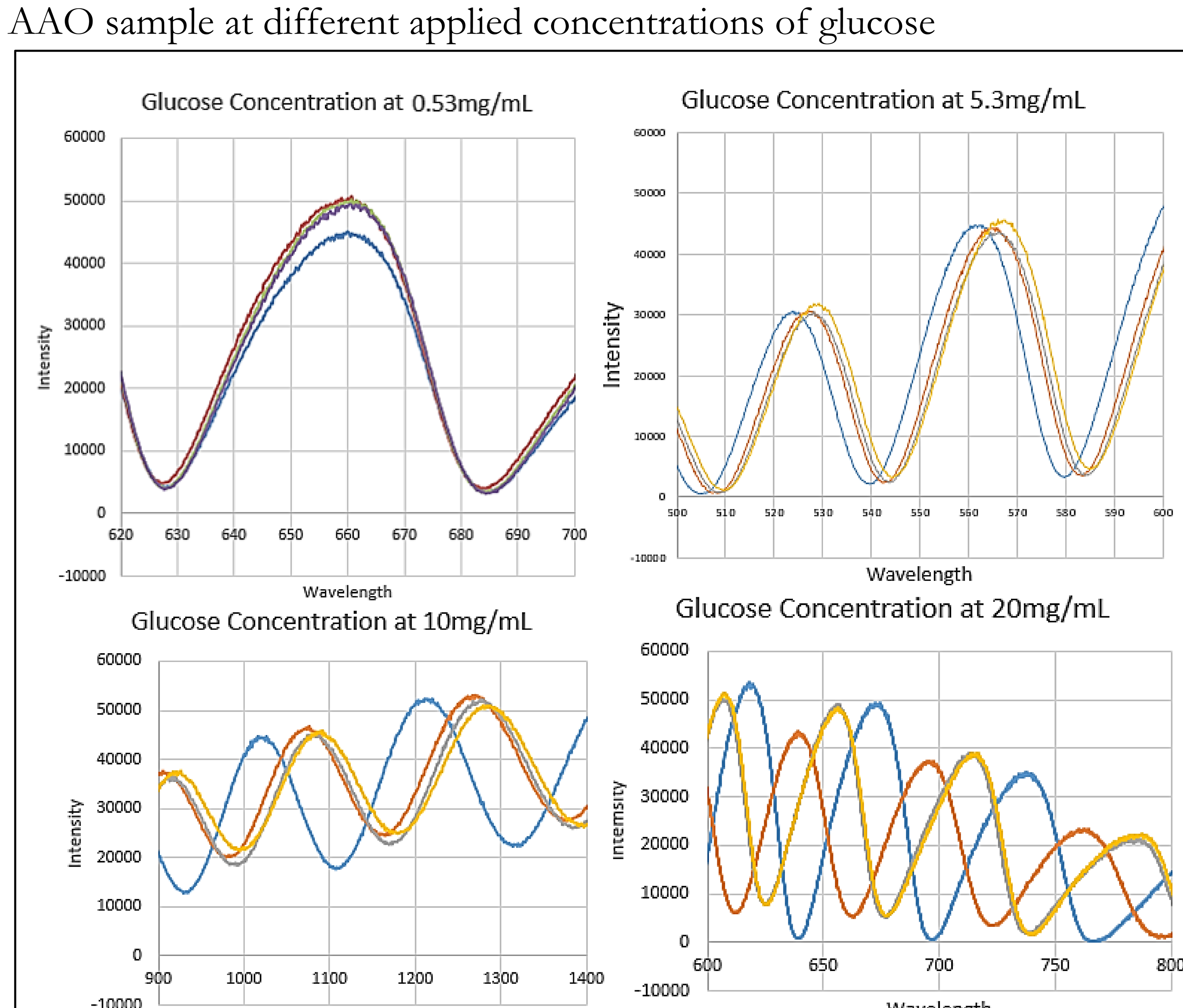

Figure 5

Our AAO samples were able to detect glucose concentrations from a range of 0.53mg/mL to 20mg/mL with observable wavelength shifts.

VII. Shift of Wavelength vs Glucose Concentration

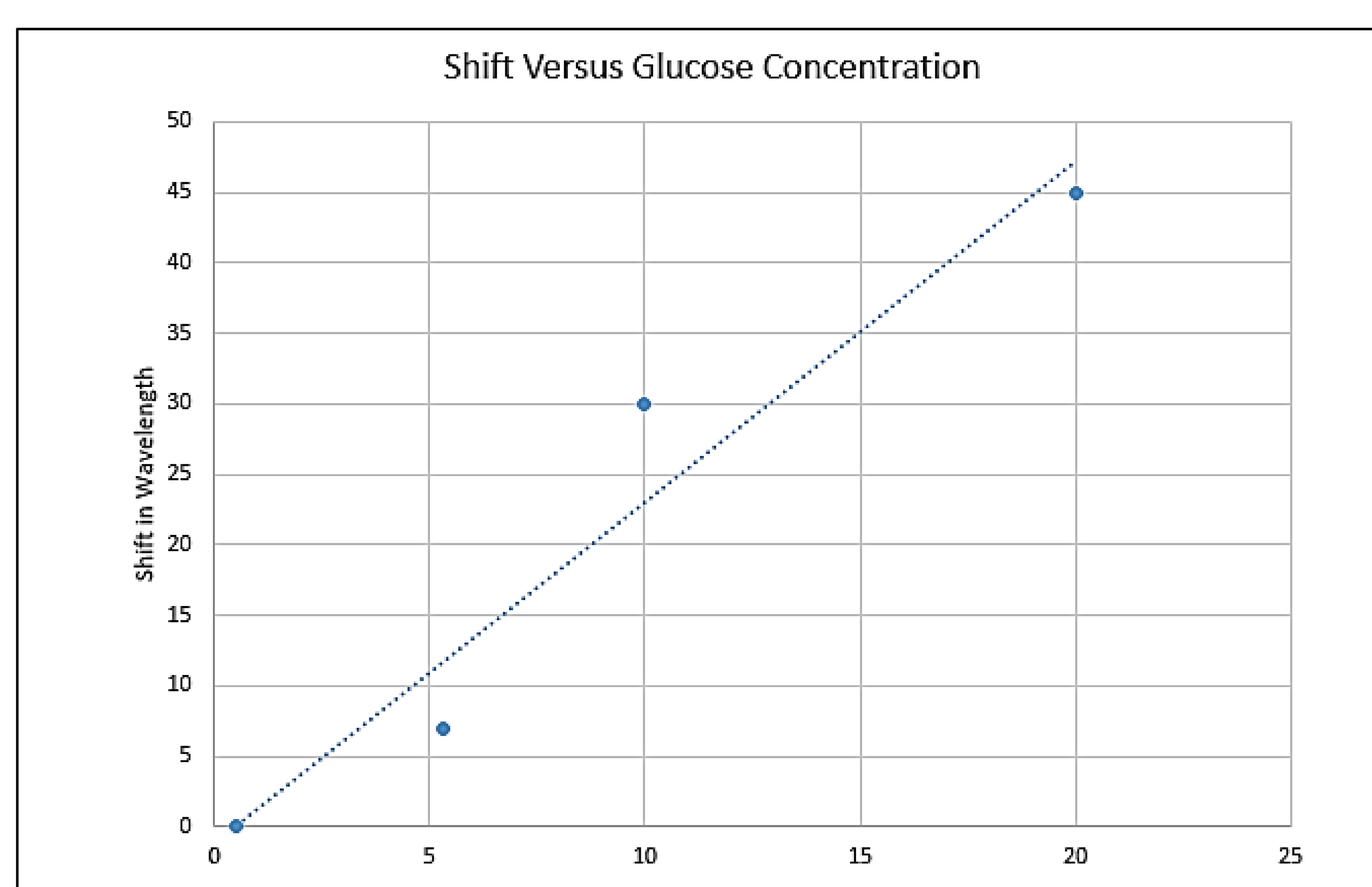

Figure 6

Figure 6 demonstrated that the shift of wavelength in terms of glucose concentration is a linear relationship. This allows wavelength data to be translated confidently into a specific concentration of glucose.

References

[1] T. Zhang, Y. He, J. Wei and L. Que, "Nanostructured optical microchips for cancer biomarker detection", *Doi.org*, 2012. [Online]. Available: http://doi.org/10.1016/j.bios.2012.06.029. [Accessed: 16- Apr- 2017].