A Biosensor for the Personalized Health Care of Diabetes

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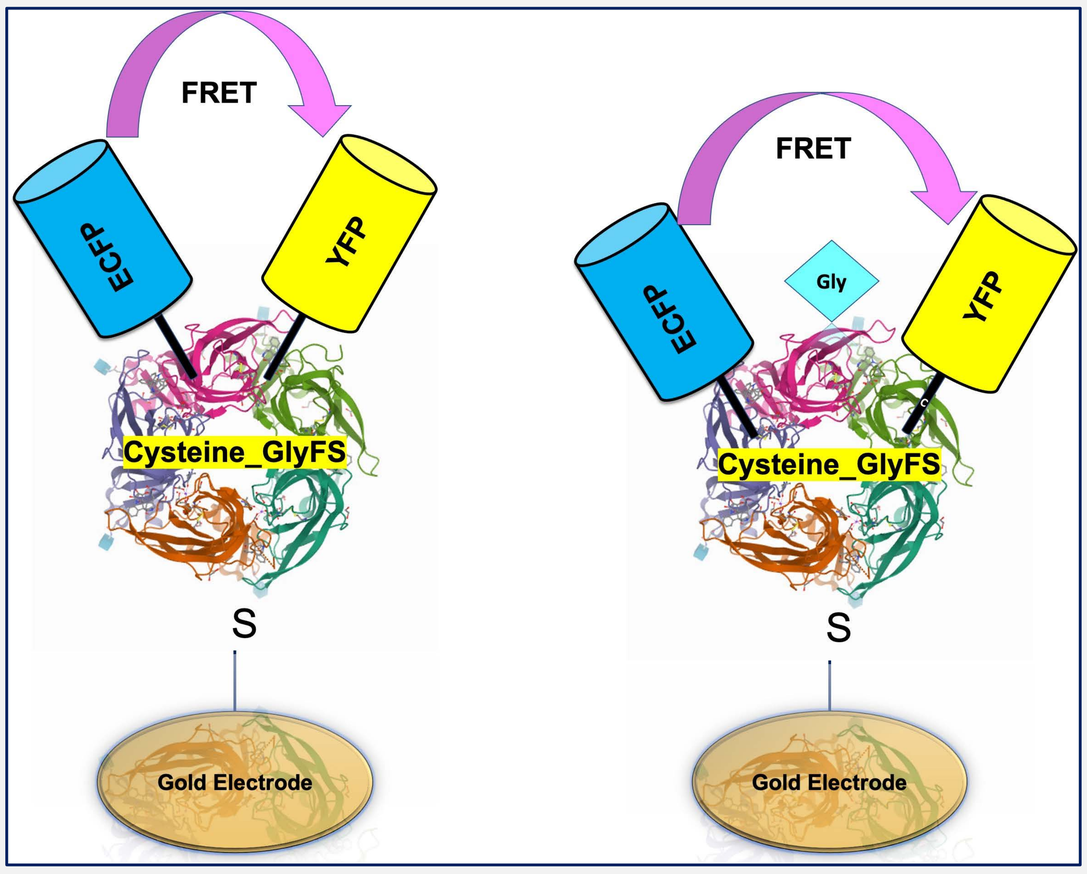
Introduction

- Diabetes is a condition in which the glucose concentration in blood is elevated due to insufficient insulin production from the pancreas.
- Bioanalytical sensors have revolutionized the field of medical diagnostics and can be integrated into point of care devices for personalized diagnostic care.
- Abnormal glycine levels are a biomarker for the development of diabetes.
- In this work, we immobilized a FRET glycine biosensor on the surface of a screen-printed gold electrode and demonstrated its ability to monitor glycine levels at micro-millimolar concentrations.

Aim

- To develop a glycine biosensor-based point-of-care device, to be used in the early detection of diabetes.

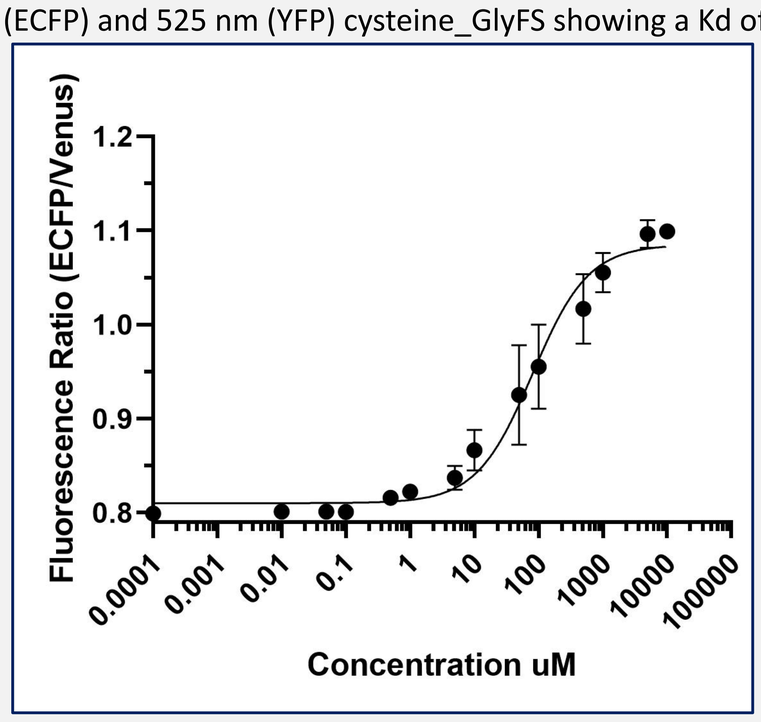


- Schematic model shows in the absence of ligand, binding core adopts a closed form upon glycine binding, leading to an open form.

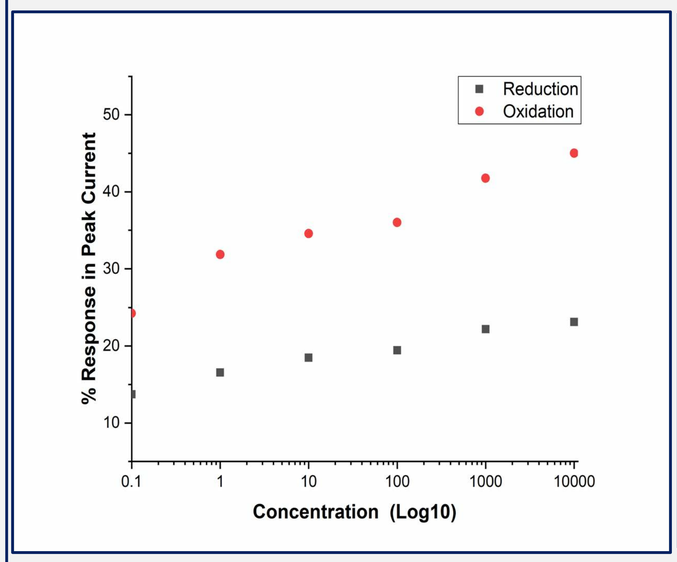
Results and Discussion

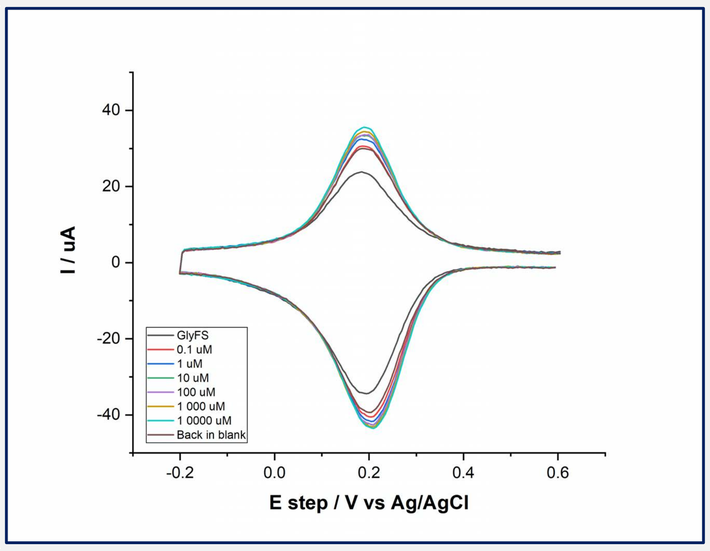
Fluorescence Titration:

- Sigmoidal curve of cysteine_GlyFS shows a ligand-dependent ECFP/YFP fluorescence ratio range.
- ECFP/Venus ratios were determined using a peak wavelength values of 476 nm (ECFP) and 525 nm (YFP) cysteine_GlyFS showing a Kd of 80 µM.



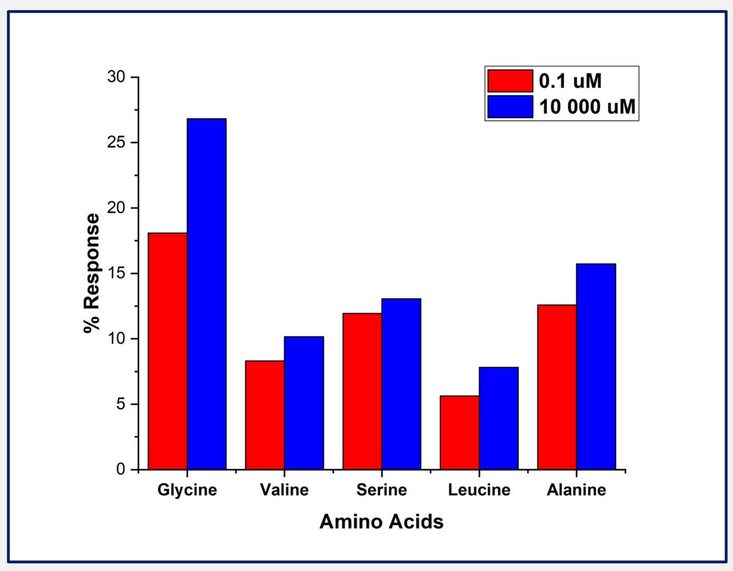
Electrochemistry Results:





- Screen-printed gold electrodes were functionalized with cysteine_GlyFS and then exposed to different concentrations of glycine.
- The signal was monitored through cyclic and differential pulse voltammetry using a redox label (ferricyanide).

Selectivity for amino acids-Cysteine_GlyFS



- Bar plot shows that the changes with respect to glycine is still highest which shows immobilized cysteine_ GlyFS sensor on an electrode does have the higher selectivity for glycine.

Conclusion

- Following, cysteine_GlyFS sensor optimization to be able to generate a observable signal from the binding core, this platform will be miniaturized.
- This work will lead us towards a point-of –care detection system for the early detection of type-1 diabetes.
- This biosensors will be an important step towards the sensors capable of on-demand, continuous, and non-invasive sensing of any analyte of choice.

References

- Hyun J. Kwon et al., Simulation of cyclic voltammetry of redox reaction in the EQCM Sensor, COMSOL, 2011.
- William H. Zhang, et al., Monitoring hippocampal glycine with the computationally designed optical sensor GlyFS, Nature Chemical Biology.