Quartz crystal microbalance and surface plasmon resonance studies of glycomaterials

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Introduction

The purpose of this research is to understand the applications of Localized Surface Plasmon Resonance (LSPR) for studying polymer degradation. Traditionally, Surface Plasmon Resonance (SPR) instruments produce an evanescent field from a thin gold film bound to glass. LSPR utilizes gold nanoparticles which produce much smaller evanescent fields.

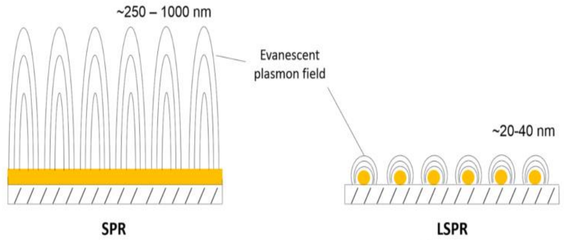

Figure 1. Schematic of Traditional versus Localized SPR sensors

Research Questions

What is the applicability of LSPR technology to glycomaterials and polymer degradation? Can we simultaneously probe enzyme binding kinetics while studying polymer degradation?

Methods

Our experiments utilize trimethylsilyl derivatives of cellulose. The addition of TMS groups transform these materials into soluble polymers that can be uniformly spin coated into films of various thicknesses. For degradation, the polymer films will be degraded enzymatically.

Results

- Figure 2 exhibits distinct binding and degradation regions that are highlighted for cellulase catalyzed degradation of a cellulose film.
- During binding, enzyme from solution binds to the polymer surface the signal response increases indicating an increase in adsorbed material.
- The degradation curve exhibits relatively exponential decay and returns to below zero signal response, which indicates an equivalent amount of material was removed from the surface through degradation as was added during binding.
- On longer timescales it is anticipated that the degradation curve will continue to decrease as more polymer is degraded and detaches from the surface.

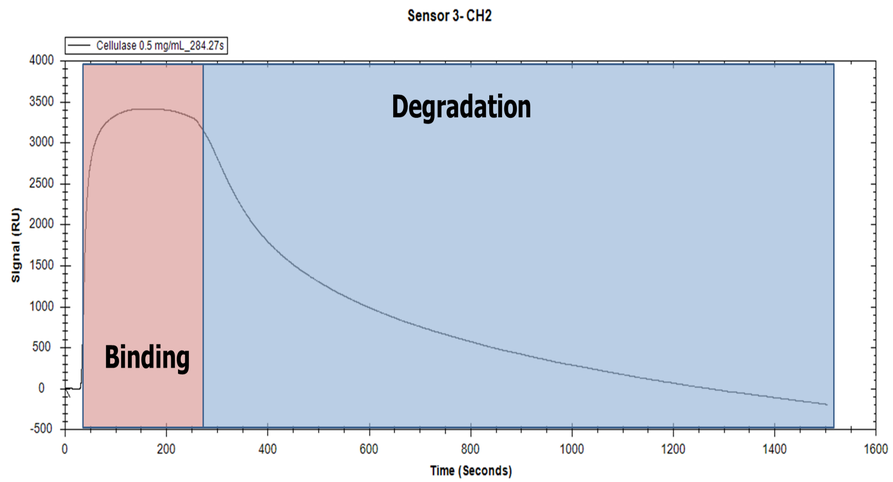

Figure 2. LSPR data for cellulose degradation with cellulase enzyme.

Conclusion

We have obtained preliminary results demonstrating that LSPR can be an effective technology for the study of degradation of polymer films. This work lays the foundation for more precise usage of surface plasmon resonance technology than was previously possible.

We have plans to extend this work to the synthesis of polymer films during LSPR experiments. Additionally, we believe that LSPR can be paired with the Glyconeer to synthesize and degrade discrete glycomaterials.

Acknowledgement

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References

1. https://nicoyalife.com/nicoya-surface-plasmon-resonance-resources/what-is-spr/lspr-vs-spr-2/