Fetuin-A adsorption to polydimethylsiloxane with varying elastic modulus

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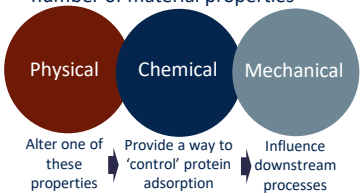
Introduction

An early biological response to the introduction of biomaterials, **protein adsorption** is a precursor to cellular adhesion, thrombus formation, and inflammation

- Total amount and orientation of adsorbed protein influenced by a number of material properties



Polydimethylsiloxane (PDMS)

- Tunable elastic modulus that covers a range of biologically relevant stiffnesses[1]

PDMS Mix	Elastic Modulus
Sylgard 184	4.20 MPa
5:1 (Syl 184:Syl 527)	3.97 MPa
1:1 (Syl 184:Syl 527)	2.06 MPa
1:5 (Syl 184:Syl 527)	0.35 MPa
0.50% PDMS-PEG	3.11 MPa

Fetuin-A

- Globular plasma protein present in all major organs during fetal development[2]
- Shown to adsorb to biomaterials in significant amounts affecting cell response[3]

Hypothesized functions include:

- Regulation of mineralization[2]
- Pro- and anti- inflammatory responses[4]

Research Aims

Altering the **surface modulus** of an underlying biomaterial has an impact on the subsequent adsorbed protein layer[5,6]. Our aims are to:

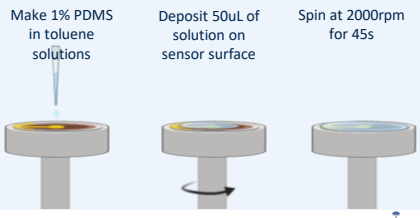
1. **Characterize** PDMS samples
2. Investigate the **amount and orientation of adsorbed Fetuin-A**

Methods

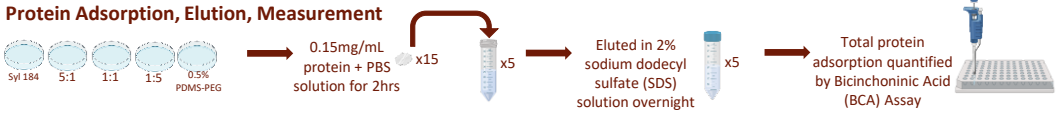
PDMS Sample Preparation

- PDMS formulations mixed from Sylgard 184 were prepared in a 10:1 ratio of base to curing agent, and Sylgard 527 was prepared in a 1:1 ratio of part A and B.
- The Sylgard 184 and 527 were then mixed in ratios of 5:1, 1:1 & 1:5.
- Mixed PDMS was poured into petri dishes and placed in a vacuum desiccator for 30mins then left to cure for 48 hours.

QCM-D Sensor Spin Coating



Protein Adsorption, Elution, Measurement



Surface Characterization

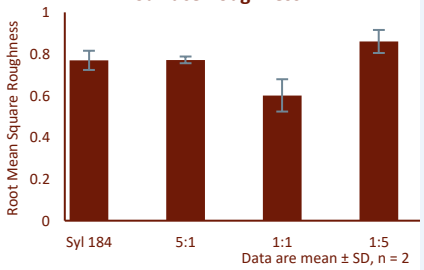
Water Contact Angle

Sample	Average (°)	SD
Sylgard 184	107	3
5:1	108	3
1:1	109	3
1:5	105	3
0.5% PDMS-PEG	52	2

Data are mean ± SD, n = 7

- Similar angles across all but the PDMS-PEG formulation
- No change in wetting with increasing Sylgard 527

Surface Roughness



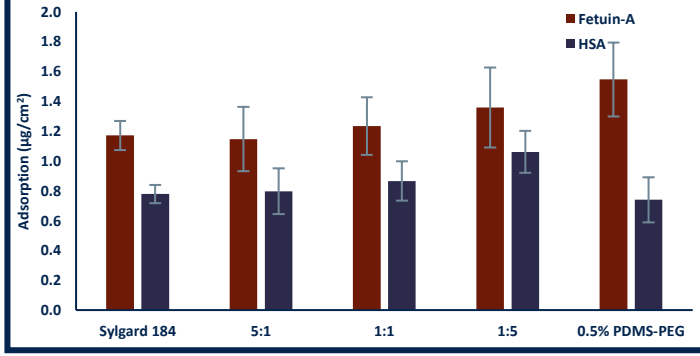
- RMS Roughness < 1nm across all samples
- No noticeable trend though experiment should be repeated with new AFM tips

XPS

At %	PDMS	0.5% PDMS-PEG
C	44.61	44.10
O	31.23	31.40
Si	24.17	24.50

- No significant difference suggest the PDMS-PEG was not at the surface during the XPS measurement

Protein Adsorption



Data are mean ± SD, n=5

- Overall greater adsorption of Fetuin-A over Human Serum Albumin
- No demonstration that changing surface modulus impacts total protein adsorption amounts
- Do not see the expected impact of 0.5% PDMS-PEG samples

Conclusions

- Varying PDMS formulation has **no measurable impact on surface wetting properties**, as determined by water contact angle
- The addition of PDMS-PEG copolymer to Sylgard 184 **increases the hydrophilicity** of the surface
- Surface roughness **does not seems to increase** with the addition of Sylgard 527
- **Increased fetuin-A adsorption over BSA** consistent on all Sylgard 184 + PDMS-PEG samples
- Current preparation of 0.5% PDMS-PEG samples is not suitable for the **expression of PEG chains** at all times

Future Work

- Quartz Crystal Microbalance with Dissipation measurements in progress to determine **total adsorption** and indicate the **adsorption state** of the protein
- Adsorption from plasma to determine how fetuin-A adsorbs in **competitive environments**
- Macrophage studies to determine the **pro- or anti-inflammatory** effect of fetuin-A

References

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