Utilizing Shape Memory Polymers to Generate Complex Wrinkles for Active Cell Culture

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Probing Cell Material Interactions

Static Biomaterial Systems

- Very Precise, but not dynamic

Dynamic Biomaterial Systems

- Dynamic, but not as precise as Static

Active Wrinkling on SMP Substrates

- Heat
- Stretch
- Au Sputter Coat

Wrinkles on Triple Shape Memory Composites

- Temperature (deg C)
- Gold layer
- Wrinkles

Strain Amount and Angle Between Strains

- 5% Total Strain
- 2.5% PCL 2.5% Epoxy
- 10% Total Strain
- 5% PCL 5% Epoxy
- 20% Total Strain
- 10% PCL 10% Epoxy

Impact of Strain Ratio

- 1.3 Ratio of Strain between the PCL:Epoxy
- 1.1 Ratio of Strain between the PCL:Epoxy

Time Between Recoveries

- 2.5 PCL 2.5 Epoxy at a 90 angle
- 3.75 PCL 7.5 Epoxy at a 90 angle

Conclusions

- Many factors impact complex wrinkling formation including:
  - the amount of strain,
  - the angle between the two programmed strains,
  - the ratio between the two programmed strains,
  - the time between the two recoveries.

- By understanding all of these variables, we can control the pattern formation along the surface and potentially use these patterns to impact cell behavior.

Future Work

- Adjust the material chemistry to a cyto-compatible material platform and assess cell behavior in response to static complex wrinkled patterns.
- Design a new triple shape composite to allow for dynamic complex wrinkling formation during cell culture.
- Assess cell responses to dynamic pattern formation, including the potential of these patterns to impact stem cell differentiation.

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References