Time-dependent mechanical properties of PDMS for micro tissue gauges *by Nicole Bacca*

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PDMS (Polydimethylsiloxane) is commonly used for biological experiments due to its biocompatibility, and elasticity. However, the use of PDMS materials as platforms in tissue engineering, specifically as the pillars for micro tissue gauges (?TUGs), means a continuous contraction of the cells (cardiomyocytes) against the PDMS posts. This behavior created the need to know the mechanical properties of the PDMS that will receive this continuous dynamic loading. Initial *in-situ* microscale deflection tests revealed a time-dependent mechanical response from the material. Inducing cyclic deflections on the posts similar to those experienced by cardiac tissue during beating (~10 ?m) resulted in the displacements approximately 144% higher than the initial after subjection the sample to 100 cycles. Nonetheless, the experiments were carried out in a controlled environment (i.e. under vacuum, high energy electron beams), there is doubt on whether these time-dependent mechanical characteristics would vary in testing conditions more closely related to those in the ?TUGs.

Thus, to simulate the contraction of cells against the pillars with testing conditions similar to those in ?TUGs, macroscale fatigue testing was conducted on samples of PDMS. The tests ranged from 102 -104 cycles, straining the sample from a 10%-20%. Results showed a loss of energy throughout the fatigue cycles, as well as a decrease in maximum stress. Therefore, accumulated defects result in stress softening with increasing loading cycles. A plateau in the maximum stress reached throughout the test was also observed, confirming that newly linked molecular chains in the PDMS begin to adapt to a repetitive level of displacement. This study will serve as a guideline for bio-tissue engineers in their study of cardiac tissue.