Electrically Measured Force and Displacement Sensing Pillars

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MEMS polymer pillar arrays are often used to determine the force exerted by a cell or microorganism during motion. Force is calculated from displacement of the pillars using beam theory. The tip of the pillar is tracked optically to determine the maximum displacement as the organism pushes or pulls across the surface. Two of the most common tracking techniques for mapping the pillar tip are: looking at its centroid or marking the tip with florescence. The centroid approach is easier and useful as a beginning step. Including florescence is necessary if a direct view of the pillar tips is not achievable or if better resolution is desired. However, there is a limit to the sensitivity of optically tracked displacement. A means of measuring the displacement electrically, and consequently the force, may allow for a more accurate, direct measurement. The goal of this ME342 project is the fabrication, characterization, and optimization of electrically measured force sensing pillars.

The proposed pillars should deform sufficiently such that a 10 micro-Newton force creates an electrically measurable displacement. The integration between the polymer (if needed) and measuring material (such as a metal) is of concern. Potential solutions include: 1) using intrinsic stresses to create the pillars, 2) creating piezoresistive pillars coated with a polymer such as PDMS, or 3) utilizing nanowire technology. Many geometries and methods can be explored as a part of this project.

Useful References:

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