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PDMS MEMBRANE ANALYSIS FOR PIEZOELECTRIC MICROPUMP ACTUATION

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Abstract:
Microelectromechanical systems (MEMS) based piezoelectric (PZT) micropump has been extensively used in medical field for last few years. In this paper, the structural analysis of polydimethylsiloxane (PDMS) membrane has been presented that was performed using ANSYS software. ANSYS parametric design language (APDL) tool has been used for simulation and analysis. The PDMS membrane with length of 30000 µm (9843 µft), width of 10000 µm (3281 µft) and thickness of 500 µm (1640 µft) to 3000 µm (9843 µft) has been used for analysis. The pressure range of 1-4 kPa (0.15-0.58 psi) has been applied on membrane and the effects of stress and deflection have been observed at various thickness parameters. At applied pressure of 1 kPa (0.15 psi), the deflection of 0.053 µm (0.17 µft) and the stress of 0.65 MPa (94 psi) have been observed. At applied pressure of 4 kPa (0.58 psi), total deflection of 0.211 µm (0.7 µft) and stress of 2.62 MPa (380 psi) have been obtained. The stress and deflection variations due to thickness changes have been observed. At 250 µm (820 µft) of membrane thickness, the net deflection is observed to be 1.2 µm (3.9 µft). On the other hand, at 2000 µm (6562 µft) thickness, the deflection decreases up to 0.0029 µm (0.0095 µft). It has been observed that the maximum stress of 2.54 µm (8.3 µft) and 0.128 µm (0.42 µft) have been obtained at 250 µm (820 µft) and 2000 µm (6562 µft) thickness of membrane, respectively. Thickness is most important parameters in micropump actuator and has direct impact of fluid flow through the micropump outlet. The deflection of membrane can be changed by changing its thickness.

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