Characterization of PZT Thin Film Deposited on Si Cantilever Embedded in PDMS for Tactile Sensing as Force and Vibration Detection

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Humans have tactile receptors which respond to force and vibrational stimuli. We have demonstrated a method that can detect force and vibration by a model constructed using a piezoelectric film and a strain gauge installed in a single cantilever embedded in the PDMS elastomer. In this work, we have fabricated and characterized Si micro-sized cantilever with PZT thin film embedded in the PDMS for vibration sensing.

Figure 1 shows the (a) cross-sectional structure of the sensor and (b) a SEM image of fabricated Si micro-cantilever with PZT thin film capacitor deposited by the RF-magnetron sputtering. The cantilever is embedded in the PDMS as the contact part for tactile sensing. To enhance the sensitivity, the sensor has a cavity under the cantilever. The cantilever is slightly warped upward due to the stress induced by PZT deposition.

Figure 2 shows the output voltage from PZT capacitor on the cantilever measured with an oscilloscope when 500 Hz vibration is applied to the PDMS of the sensor using a vibration generator. It is confirmed that the output voltage includes 500 Hz signal. The output voltage per vibration amplitude increased moderately as a function of the frequency. From these results, it is demonstrated that vibration can be detected with Si cantilever with PZT thin film embedded in the PDMS and it is suggested that the feasibility of combined detection of force and vibration using micro-cantilever integrated with strain gauge and PZT thin films.