Microcantilever－Based Flow Sensor

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ABSTRACT

Goal of this study is to manufacture the micro-sensor that using the residual stress and piezoresistive characteristic to achieve sensing wind speed and direction. The presented micro sensor not only has a smaller volume than a traditional sensor, but also can make more accurate measurement and higher sensitivity due to the miniaturized dimension. In previous studies, the main methods include single cantilever, hot-wire anemometer (HWA), and four cantilevers. The problem of sensing function of direction can be solved by hot-wire anemometer and four cantilever. The latter does not need to provide power, and also added a sense of wind direction. This study used a silicon wafer that is deposited silicon nitride layers, and platinum resistors to be piezoresistors. The micro sensor is composed of four cantilever structure that is released by a bulk micromaching process. When the cantilever beam is shaped after etching the silicon wafer, a bended cantilever beam is made due to residual stress. Then, when air flows through the cantilever beam, deformation happens. We can get the airflow velocity and direction after measuring the resistance variation. Using different wind directions (0 ° -360 °) and speeds (15 m/s, 20 m/s, 25 m/s, and 30 m/s) to measure resistance changes, and the results showed a regular waveform, which means the sensor can precisely measure the wind direction. Furthermore, the total resistance variation of 1.2 Ω was measured when the wind speed was 15 m/s. As the wind speed was 20 m/s, the piezoresistance change is above 2 Ω. The maximum variation was 3.5 Ω as the wind speed was 30 m/s. The trend of the sensing scope can also be predicted.

Keywords : Residual Stress, Bulk Micromaching, Micro-cantilever, piezoresistor, Micro-Electro-Mechanical System(MEMS)

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