

Silicon Piezoresistive Six-Degree of Freedom Force-Moment Micro Sensor

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In this paper, we describe the design, fabrication and calibration results of a 6-degree of freedom force-moment micro sensing chip utilizing the piezoresistance effect in silicon. The sensing chip is designed to be able to simultaneously detect three components of force and three components of moment in three orthogonal directions. Conventional p-type and four-terminal p-type piezoresistors have been combined in this single sensing chip in the (111) plane of silicon. The total number of piezoresistors is 18, much fewer than the previous piezoresistance-based 6-component force moment sensors known to the authors. Calibration results show linear output responses (the maximum nonlinearity is 2% F.S.), and small crosstalk (the maximum crosstalk is less than 4%). The immediate purpose of the sensing chip development is to measure the forces and moments acting on boundary particles in a turbulent liquid flow. The configuration of the turbulent flow sensor and the preliminary results of an experiment in a water channel are presented.

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