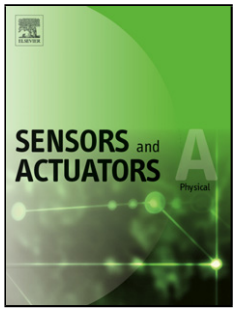

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Process development of an all-silicon capacitive accelerometer with a highly symmetrical spring-mass structure etched in TMAH+Triton-X-100

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Abstract:
This paper reports a fabrication process of a capacitive microelectromechanical system (MEMS) accelerometer with a highly symmetrical spring-mass structure for the high device performance, which is composed of eight springs and a central mass. The sandwich accelerometer is constituted by top layer, middle layer and bottom layer. The suspended spring-mass structure in the middle silicon layer is formed simply by double thermally grown oxide layers and the mask-maskless wet anisotropic etching, avoiding the generally adopted deep-groove photolithography when fabricating the thin spring. Moreover, the gap between electrodes can be determined by the thickness of the oxide layer in this process. The surfactant-modified TMAH is selected as the etchant because it not only provides the minimum undercutting at the mass corner, thus saving much space of the compensation parts, but also allows the good control of spring thickness at the low etch rate. The spring shape evolution during etching in surfactant-modified TMAH is simulated and the obtained rhombic cross-section has the advantage of easily identifying the thickness of the spring from its width according to their crystal orientation relation. The three silicon layers are bonded through silicon fusion bonding (SFB) at temperature >1000 ◦C to relax surface stresses that could be present in the material prior bonding. Preliminary test result shows the sensitivity of 60 mV/g with good linearity of R^2=0.99979 in a closed-loop interface circuit. The advanced accelerometer performance could be expected due to the symmetrical structure, the large proof mass, controllable spring shape, the narrow uniform capacitive gap, and the IC-compatible process.