Reducing Parasitic Effects of Actuation and Sensing Schemes for Piezoelectric Microelectromechanical Resonators

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Abstract: The co-integration of piezoelectric actuation and sensing capabilities on microelectromechanical system-based resonators can be a source of electrical cross-talk that, if not properly taken into account, may dramatically affect the interpretation of the device's output. In this paper, we identify three parasitic electrical effects pertaining to the most commonly used piezoelectric actuation and sensing schemes. To further investigate the impact of such parasitic effects, microcantilevers, bridges and membranes integrating a layer of sal-gel lead zirconate titanate (PZT) were fabricated and electrically characterized. Experimental results on the resonant characteristics were compared with simulations of the studied resonators' equivalent electrical models. Methods for reducing the design-dependent parasitic electrical effects such as mutual capacitances of less than 10 fF, electrical wiring or static capacitance mismatches of less than 20% of the integrated piezoelectric films are discussed.