engineering proceedings

Abstract

On-Chip Assessment of Scattering in the Response of Si-Based Microdevices †

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† Presented at the 1st International Conference on Micromachines and Applications, 15–30 April 2021; Available online: https://micromachines2021.sciforum.net/.

Abstract: The response of micromachines to the external actions is typically affected by a scattering, which is, on its own, induced by their microstructure and by stages of the microfabrication process. The progressive reduction in size of the mechanical components, forced by a path towards (further) miniaturization, has recently enhanced the outcomes of the aforementioned scattering, and provided a burst in research activities to address issues linked to its assessment. In this work, we discuss the features of an on-chip testing device that we purposely designed to efficiently estimate the two major sources of scattering affecting inertial, polysilicon-based micromachines: the morphology of the silicon film constituting the movable parts of the device, and the etch defect or over-etch induced by microfabrication. The coupled electro-mechanical behavior of the statically determinate movable (micro)structure of the on-chip device has been modeled via beam bending theory, within which the aforementioned sources of scattering have been accounted for through local fluctuating fields in the compliant part of the structure itself, namely the supporting spring. The proposed stochastic model is shown to outperform former ones available in the literature, which neglected the simultaneous and interacting effects of the two mentioned sources on the measure response. The model can fully catch the scattering in the C–V plots up to pull-in, hence, also in the nonlinear working regime of the device.

Keywords: polysilicon morphology; over-etch; sensitivity to imperfections

Citation: Ghisi, A.; Mariani, S. On-Chip Assessment of Scattering in the Response of Si-Based Microdevices. *Eng. Proc.* **2021**, *4*, 18. https://doi.org/10.3390/Micromachines2021-09555

Published: 14 April 2021

Supplementary Materials: The supplementary file is available online at https://www.mdpi.com/2673-4591/4/1/18/s1.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.