Thin-film silicon MEMS sensor arrays

Proposers

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Introduction

Micro- and nanoelectromechanical resonators (MEMS and NEMS) show resonance frequencies that can vary from kHz to GHz and quality factors up to 10^7. MEMS resonators are fabricated using clean room micro and nanofabrication techniques and a variety of structures and resonant modes are available (flexural, torsional, bulk resonators, for example). MEMS and NEMS resonators are promising devices for multiple high-performance sensing applications. At INESC MN we have developed a low-temperature, large-area process for the fabrication of thin-film silicon MEMS resonators that allows these resonators to be implemented on glass and flexible polymeric substrates. The objective of this project is to demonstrate a MEMS sensor array and show that it can be used to dramatically increase the performance of the sensing system.

Partner 1

The Thin-Film MEMS and BioMEMS group at INESC MN (www.inesc-mn.pt) studies microsystems that integrate silicon thin-films in either MEMS or microfluidics.

Partner 2

The Analog and Mixed Signal group at INESC-ID (www.inesc-id.pt) studies microelectronics, analog, digital, mixed and RF that is required for biasing, reading and processing of large sensor arrays.

Project outline/goal

The noise of a sensing system decreases as the inverse square root of the number of sensors. That is why we propose to design, microfabricate, electronically address and demonstrate an array of thin-film silicon sensor system. Two configurations will be tested, analyzed and compared: MEMS sensors using static deflection and MEMS resonators. The arrays will be tested for sensing in air, and then in aqueous environment. The effect of the number of sensors in the array will be demonstrated.

In a later stage of the project, a configuration will be developed in which the individual sensors in the array are able to detect a single event, such as the capture of a single bacteria by a functionalized surface are in the MEMS sensor. The sensor array, via the individual addressing of its individual microstructures, can now be used in a digital sensor mode. We will explore how MEMS sensors can be operated in this mode, and evaluate, both theoretically and experimentally, the sensitivity gains in the digital mode of operation.

Student profile

Preference, but not limited, to students with a background in Physics with an interest in Electronics or Electrical Engineers with an interest in Physics, Devices, and Micro and Nanofabrication. Adequate to a student with an Engineering background.