

Digitally Programmable Resonator by PZT-SOI Process

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Context

Co-integration of MEMS with Integrated Circuits has been attracting major attention in the development of the micromachining technology. In most IC systems, quartz oscillator is commonly used as a frequency reference to keep track of time and to provide a stable clock signal for digital circuits or stabilize frequencies for Radio-Frequency circuits.

Objectives

MEMS Resonator as an alternative to Crystal Quartz

- Smaller, cheaper and IC compatible
- Meet the increasing count of RF components
- Meet the demand by **multi-band wireless tech.**

A single resonator → Different reference freq.

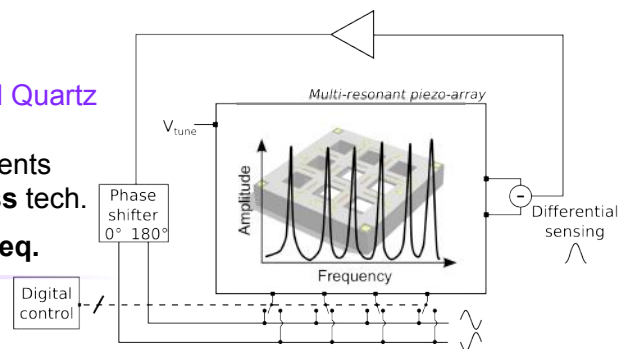


Fig. 1: Schematic of the multi-resonant device integrated with the electronics and the digital control

Methods & results

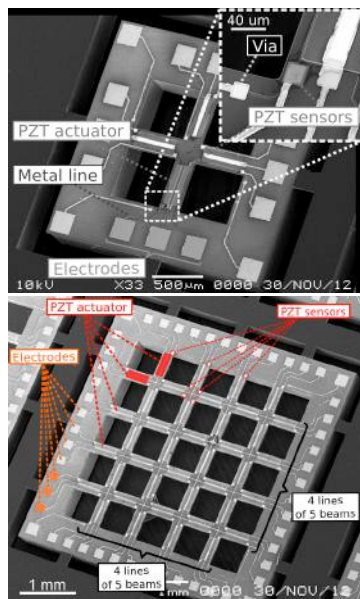


Fig. 2: SEM images of multi-resonant devices with the 4 and 40 coupled cantilevers

- The device is fabricated in a **PZT-SOI process** developed by **Stanley Electric Co., Ltd** (Japan) to integrate piezo-transducers and strain sensors on top of micro-structure
- The mechanical structure is based on the **array of coupled resonating beams**
- Device shows **more than 30 reference frequencies**

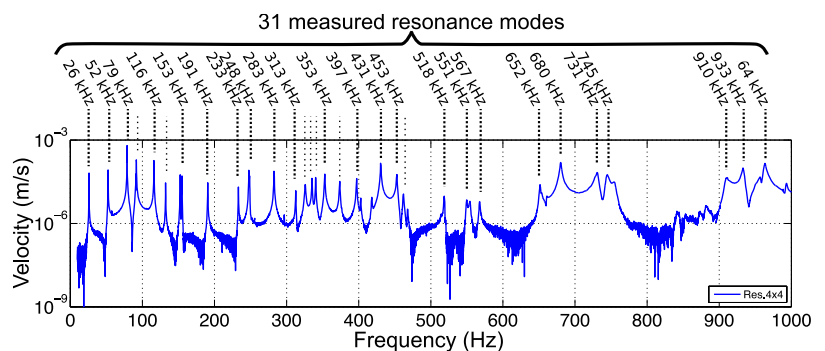


Fig. 3: Resonance modes of the 40 coupled cantilever device

Conclusions & perspectives

- Demonstration of **programmable MEMS resonators** (ie. 31 frequencies can be selected)
- Resonance freq. are **tunable** by simple polarization (up to 6% with a 25V-bias)
- Manufacturing is **IC-compatible** for ensuing co-integration with electronics

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