TECHNOLOGY OFFER

Electromechanical Actuation and Readout of Freestanding and Vertical Nanomechanical Resonators

Vertical nanomechanical structures, such as pillar resonators, are excellent for the mass detection of nanoparticles and the sensing of forces but are challenging to transduce electromechanically. As a result, vertical resonators are often measured by optical methods, which are difficult to integrate. The scattering of surface acoustic waves (SAWs) enables an electromechanical transduction of freestanding vertical resonators, such as optical methods, but does not require bulky optical components.

BACKGROUND

In the last decades, the dimensions of mechanical resonators has been pushed to the nanometer range, resulting in so-called nanoelectromechanical systems (NEMS). The trend towards ever smaller mechanical resonators is still unbroken and driven by better integrability, improved sensitivity and higher operation frequencies. The drawback of the ongoing miniaturization is the difficulty to electromechanically transduce the motion of the tiny resonators. This is especially true for nanometer-sized vertical structures, which are particularly suitable for applications such as mass spectrometry and atomic force microscopy.

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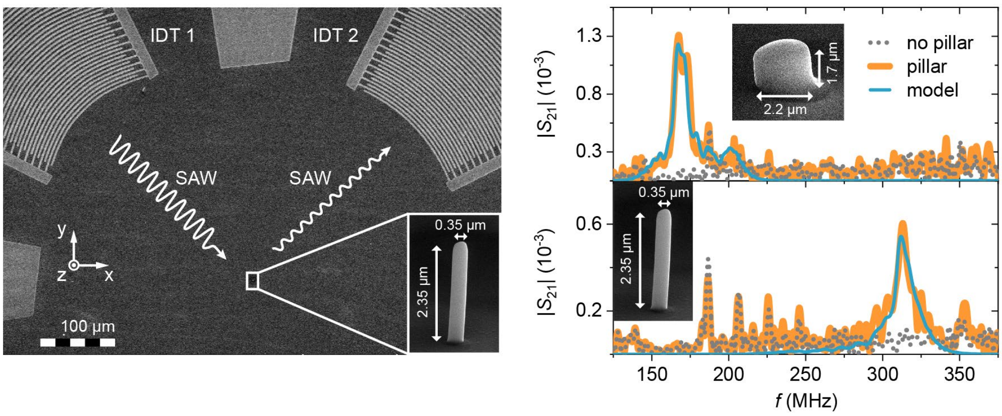
SAWs are used to electromechanically transduce the motion of vertical nanomechanical resonators: bending and compression modes. The SAWs are emitted and detected by interdigital transducers (IDTs), which are fabricated on the resonator's substrate by standard photolithography. The transduction by SAWs is based on resonant scattering. As a consequence, the shape of the resonator can be adjusted for different sensing purposes.



ADVANTAGES OVER STATE OF THE ART

- In contrast to state-of-the-art electromechanical transduction schemes, the SAW transduction does not rely on electrodes in close distance to the mechanical resonators, which enables the transduction of dense arrays of pillar resonators. Dense arrays are required for NEMS-based mass spectrometry to compensate the low probability that a molecule will land on the tiny resonators.
- An atomic force microscope (AFM) usually uses a cantilever equipped with a tip to scan a sample surface. The SAW transduction allows to use the tip itself as the sensing element instead of the cantilever. The tip resonates around hundreds of MHz, which corresponds to around 100 times faster response times to state-of-the-art cantilevers used for high-speed AFM.

REFERENCE:
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DEVELOPMENT STATUS:
Labscale proof-of-concept
TRL = 2

APPLICATIONS:
Mass spectrometry
High-speed AFM

KEYWORDS:
Pillar Resonators
Electromechanical Transduction
Surface Acoustic Waves
Nanomechanical Sensing
NEMS

IPR:
AT filed

OPTIONS:
R&D cooperation,
Development partnership,
License agreement

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