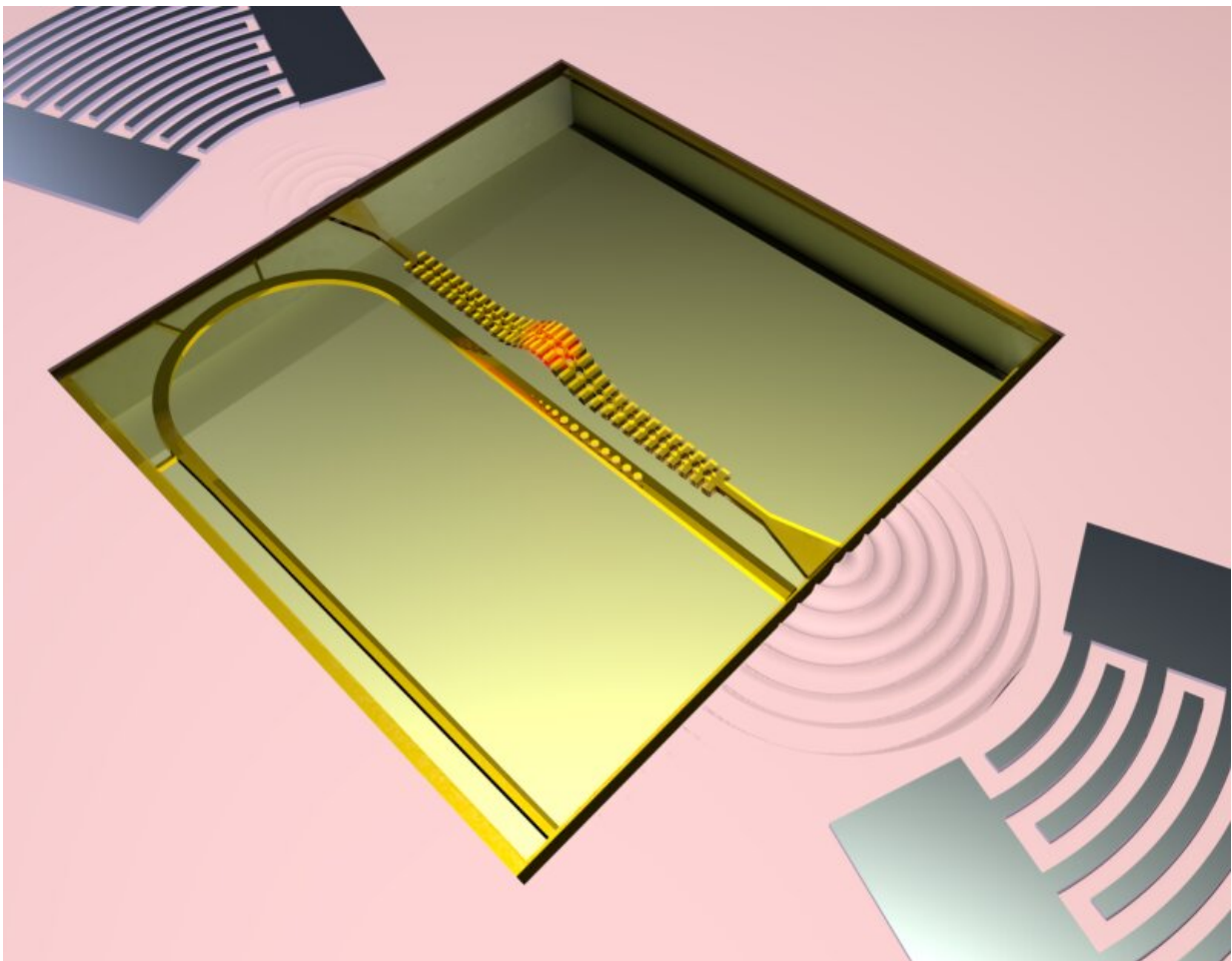


New vibes in information technology: A ground-breaking platform for advanced multi-signal systems

March 11 2022, by Virginia Greco



Credit: Dr Guilhem Madiot -ICN2

Current computer and telecommunication technologies use electrical charges (electrons) and light (photons) to transport information. However, a breakthrough in this field could be brought about by the introduction of mechanical vibrations—phonons—as a means of transferring data, in combination with the other two. In order to establish the basis for a new information technology, the researchers involved in the PHENOMEN project worked for almost four years on the development of a phonon-based signal processing system that could be incorporated in standard electronic chips.

The outcomes of this study have been recently published in a paper in *ACS Photonics* introducing a proof-of-concept technology platform for the integration of phononic, photonic and radio-frequency (RF) electronic signals, which can be operated at [ambient conditions](#) and is fully compatible with CMOS technology. These remarkable results open new avenues for [information processing](#) and transport, not only in current IT applications, but also in future quantum networks.

The researchers engineered a coherent phonon source using the opto-mechanical coupling mechanism, namely the interaction of radiation pressure forces with a resonator. The microscale resonator was designed to simultaneously sustain co-localized optical and mechanical modes. The phonon source results from an opto-mechanical interaction involving competing mechanisms: one arising from the photo-generated carriers in the resonator and the other from the temperature variation of the resonator impacting its [optical properties](#). This interaction leads to the generation of coherent vibrations, i.e., [acoustic waves](#) in-phase with each other.

The core material used to maximize the opto-mechanical interaction is nanocrystalline silicon (nc-Si), a technology developed at VTT—instead of standard crystalline silicon (c-Si)—which provides various advantages, such as: flexibility in tuning optical, mechanical and thermal

property of the system; and increased affordability, since the components can be fabricated on standard silicon wafers. The conversion of electrical signals into mechanical waves is achieved by combining silicon with aluminum nitride (AlN), which is a piezoelectric material; i.e., a material able to produce electricity upon application of mechanical stress. Both solutions represent a great innovation in the design and fabrication of NOEMS.

This novel silicon-compatible platform for nano-electro-opto-[mechanical systems](#), which allows converting electric signals into optical ones via mechanical waves (and the other way around), was shown to operate at radio-frequencies (up to a few GHz) and at room temperature, thus it can be incorporated in CMOS fabrication processes. Therefore, it has the potential to become a ground-breaking solution for new, multifunctional and multi-signal technologies for information transmission and processing, both in the classic and the quantum domain.

More information: Daniel Navarro-Urrios et al, Room-Temperature Silicon Platform for GHz-Frequency Nanoelectro-Opto-Mechanical Systems, *ACS Photonics* (2022). [DOI: 10.1021/acsp Photonics.1c01614](https://doi.org/10.1021/acsp Photonics.1c01614)

Provided by Catalan Institute of Nanoscience and Nanotechnology

Citation: New vibes in information technology: A ground-breaking platform for advanced multi-signal systems (2022, March 11) retrieved 25 April 2024 from <https://phys.org/news/2022-03-vibes-technology-ground-breaking-platform-advanced.html>

| |
|--|
| <p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p> |
|--|