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A highly sensitive microscopic microphone based on cavity opto-mechanics

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Accurate measurement of audio and ultrasonic waves is important in many applications of science, industry and medical diagnoses. The working principle of most generic microphones is based on measuring the displacement of a flexible mechanical element, which can be monitored via electrical, magnetic and optical probing methods. Optical-based approaches enable remote measurement, higher resolution and insensitivity to electrical disturbances. However, current optical acoustic sensors have two main drawbacks: low measurement bandwidth and non-chip-scale dimensions. This is disadvantageous in applications such as medical imaging and tomography in which high spatial resolution is required at ultrasound regime. However, it is challenging to preserve high sensitivities in small-size sensors since in most acoustic sensors, the pressure force applied to the sensor scales with the sensing area. Therefore, there is a trade-off between the spatial resolution (sensor size) and the sensitivity in the current optical acoustic sensors, especially those operating at ultrasonic regime. In this work, we demonstrate a micro-scale on-chip cavity opto-mechanical acoustic sensor which provides several orders of magnitude enhancement in ultrasound sensitivity compared to previous sensors of similar scale. The bandwidth of the sensor ranges from audio to ultrasound achieving a sensitivity of 3 $\mu Pa/\sqrt{Hz}$, the fundamental limit of a gaseous environment due to thermomechanical noise. Further, the sensor has a dynamic range of greater than 110 dB.

Biography

Sahar Basiri-Esfahani completed her PhD in 2015 in Professor Gerard Milburn's group at the University of Queensland in Australia. Her PhD work was mainly focused on quantum measurement and control in single photon cavity opto-mechanics. She has then worked at Queensland Quantum Optics Lab as a Postdoctoral Researcher until 2017. She is now a Sêr Cymru COFUND Fellow working at the Physics Department of Swansea University in the area of open Quantum Systems.

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