Researchers develop acoustic cylindrical shell to measure liquid properties

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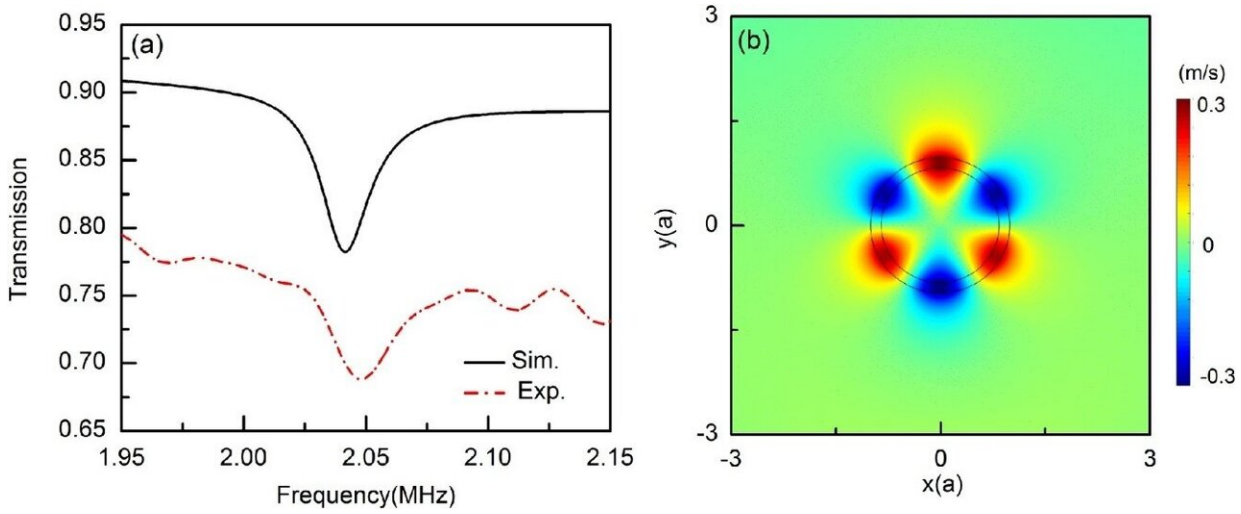

Credit: *Sensors and Actuators A: Physical* (2020). DOI: 10.1016/j.sna.2020.111843

Researchers from the Shenzhen Institutes of Advanced Technology (SIAT) of the Chinese Academy of Sciences developed a compact liquid sensor based on a liquid-filled glass cylindrical shell. Intrinsic circumferential modes of the cylindrical shell were excited acoustically and subsequently detected.

The circumferential resonances of the cylindrical shell could be used to sense the properties of liquid. The corresponding resonant field was

confined at the shell surface and enhanced the interaction between the acoustic wave and the liquid sample in the shell, improving the sensitivity.

Rapid and precise analyzing of the properties of a liquid is needed in the fields such as food quality control, petrochemical composition analyzing and environmental monitoring.

Phononic crystals, which are efficient in modulating the propagation and distribution of acoustic waves, have been designed as liquid sensors based on localized modes. However, the complex structure of this kind of sensors limits their portability and integration capabilities, and most sensors based on phononic crystals remain as early-stage laboratory prototypes.

Based on previous analytical optimization, Dr. Lin Qin from SIAT developed the fabricated system comprised of a glass cylindrical shell with an outer radius of 150.01μm, an inner radius of 119.98μm, and a length of 10 mm. The shell was filled with the liquid to be sensed, and the sensor sample volume was approximately 0.45 μL.

To evaluate the performance of the cylindrical-shell system, the researchers investigated the transmission coefficients of mixtures of water and sodium iodide (NaI) of varying concentrations inside the shell. There is always pure water around the shell.

When a plane acoustic wave of proper resonance frequency traveled through the shell filled with the liquid medium and excited the circumferential resonance of the shell, the acoustic field localized around the shell surface could interacted intensively with the liquid sample.

The resonant transmission dip was strongly dependent on the acoustic

properties of the liquid. Therefore, the position of the resonant transmission dip could be used to measure the acoustic properties of the liquid.

The cylindrical shell is disposable and compatible with other microfluidic components, and it could to be integrated with lab-on-a-chip devices for various microfluidic sensing applications in future study.

The study was published in *Sensors and Actuators A: Physical*.

More information: Qin Lin et al. The compact acoustic liquid sensor based on the circumferential modes of a cylindrical shell, *Sensors and Actuators A: Physical* (2020). DOI: 10.1016/j.sna.2020.111843

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