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An Underwater Topological Waveguide at MHz Frequencies

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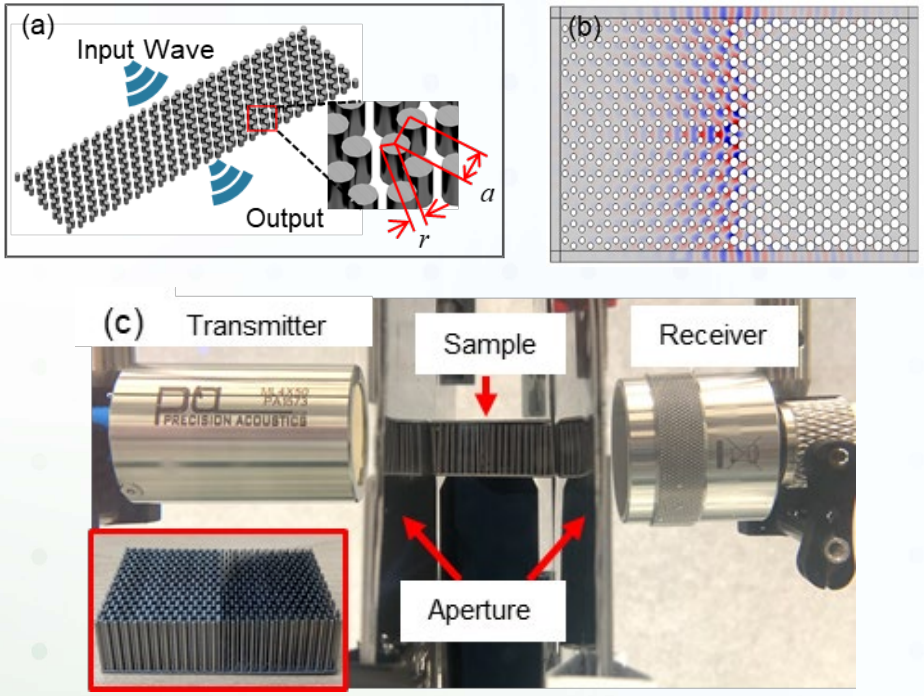
Concepts of topology recently have been brought to bear on materials designed to control sound waves. Sound wavelengths are much longer than light, making acoustic materials easier to synthesize and their behavior easier to measure. Wisconsin MRSEC researchers are using topological acoustic materials to explore topological physics and enable applications in sensing, communication, and energy transport.

The Wisconsin MRSEC team has designed and built the first underwater acoustic topological waveguide at MHz frequencies. This structure transmits ultrasound over a narrow band of wavelengths almost perfectly but blocks nearby wavelengths. Operation in water is particularly relevant to medical ultrasound imaging, since the human body is mostly water. The waveguide was formed at the interface of two hexagonal lattices with different pillar radii that were fabricated with metal additive manufacturing.



(a) Illustration of the topological waveguide. (b) Sound pressure inside the waveguide showing sound traveling along the waveguide. (c) The real waveguide being measured in the lab.

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Wang, M.Y., Thevamaran, M., Mattei, M.S., Hacha, B.G., Mazzei Capote, G.A., Yu, Z., Osswald, T., Goldsmith, R.H., Thoma, D.J. and Ma, C., 2022. Underwater ultrasonic topological waveguides by metal additive manufacturing. *Applied Physics Letters*, 120(14), p.141702.