Antireflective acoustic coatings for hiding submarines and other watercraft could be made much thinner than those in use today.

To avoid detection by sonar, submarines are often covered with sound-absorbing, perforated rubber tiles called anechoic coatings. The tiles in use today are a few centimeters thick, but the same degree of stealth protection could perhaps be provided by a much thinner coating, according to researchers in Canada and France. They predicted that a few millimeters of soft material containing regularly spaced air pockets can absorb well over 77% of the acoustic-wave energy impinging on it.

Researchers have known for some time that embedding a thin elastic layer with cylindrical, air-filled cavities makes an excellent sound absorber, but figuring out how to optimize such materials for a particular frequency or application has involved time-consuming numerical simulations. To simplify the problem, Valentin Leroy at Paris-Diderot University, France, and his colleagues modeled the cavities as spherical bubbles, each with a springy response to a pressure wave and a resonant frequency that depends
on its size and the elasticity of the surrounding material. The simplification allowed them to derive an analytical equation that relates sound attenuation at a given frequency to the material properties and cavity size and spacing.

Leroy and his colleagues found good agreement between the equation’s predictions and underwater tests bouncing megahertz waves off a 230-micrometer-thick polymer filled with air cavities and deposited on a steel slab. They have not yet tested the perforated polymers at sonar frequencies, but according to their calculations, 4-millimeter films with 2-millimeter-sized bubbles could attenuate reflected waves by more than 10,000-fold—about a hundred times better than what was previously assumed possible.

This research is published as a Rapid Communication in Physical Review B.

-Jessica Thomas

Subject Areas

Soft Matter  Metamaterials

Superabsorption of acoustic waves with bubble metascreens
Valentin Leroy, Anatoliy Strybulevych, Maxime Lanoy, Fabrice Lemoult, Arnaud Tourin, and John H. Page

Published January 6, 2015