Acoustics researchers develop novel underwater carpet cloak

July 28 2022, by LI Yuan

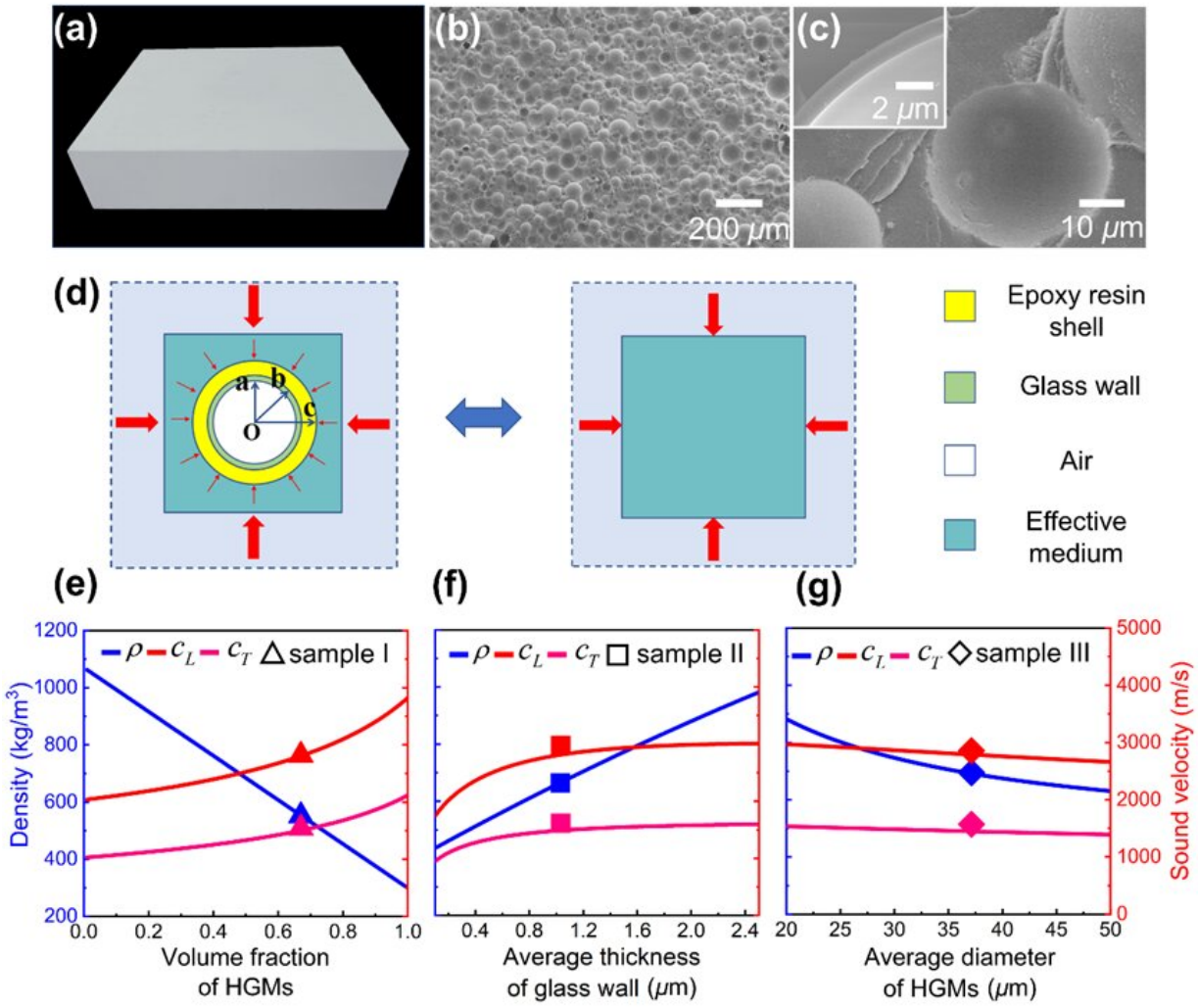

Fig. 1 Characterization of the syntactic foam. Credit: IACAS

Acoustic camouflage, realized by controlling wave propagation, has attracted much attention in recent years. Aided by a reflecting surface, acoustic carpet cloak has become one of the most practically feasible invisibility devices.

In their previous studies, researchers from the Institute of Acoustics of the Chinese Academy of Sciences (IACAS) have realized two-dimensional acoustic illusion by using a perforated plate structure in the air and then extending it underwater as a two-dimensional and three-dimensional acoustic carpet cloak. However, owing to the difficulty in the realization of ideal material parameters, the implemented cloak is still underperforming at a large angle.

To further improve the stealth performance of the underwater acoustic carpet cloak at large incident angle, IACAS researchers and their colleagues from the Technical Institute of Physics and Chemistry of the Chinese Academy of Sciences designed an underwater carpet cloak for broadband and wide-angle acoustic camouflage using a three-component metafluid composed of syntactic foam, steel and water.

The study was published in *Physical Review Applied* on July 20.

They employed a four-phase model to characterize and precisely regulate the acoustic parameters of the syntactic foam. Combined with Biot theory, they realized synergetic regulation of structure and material parameters in the design of the metafluid.

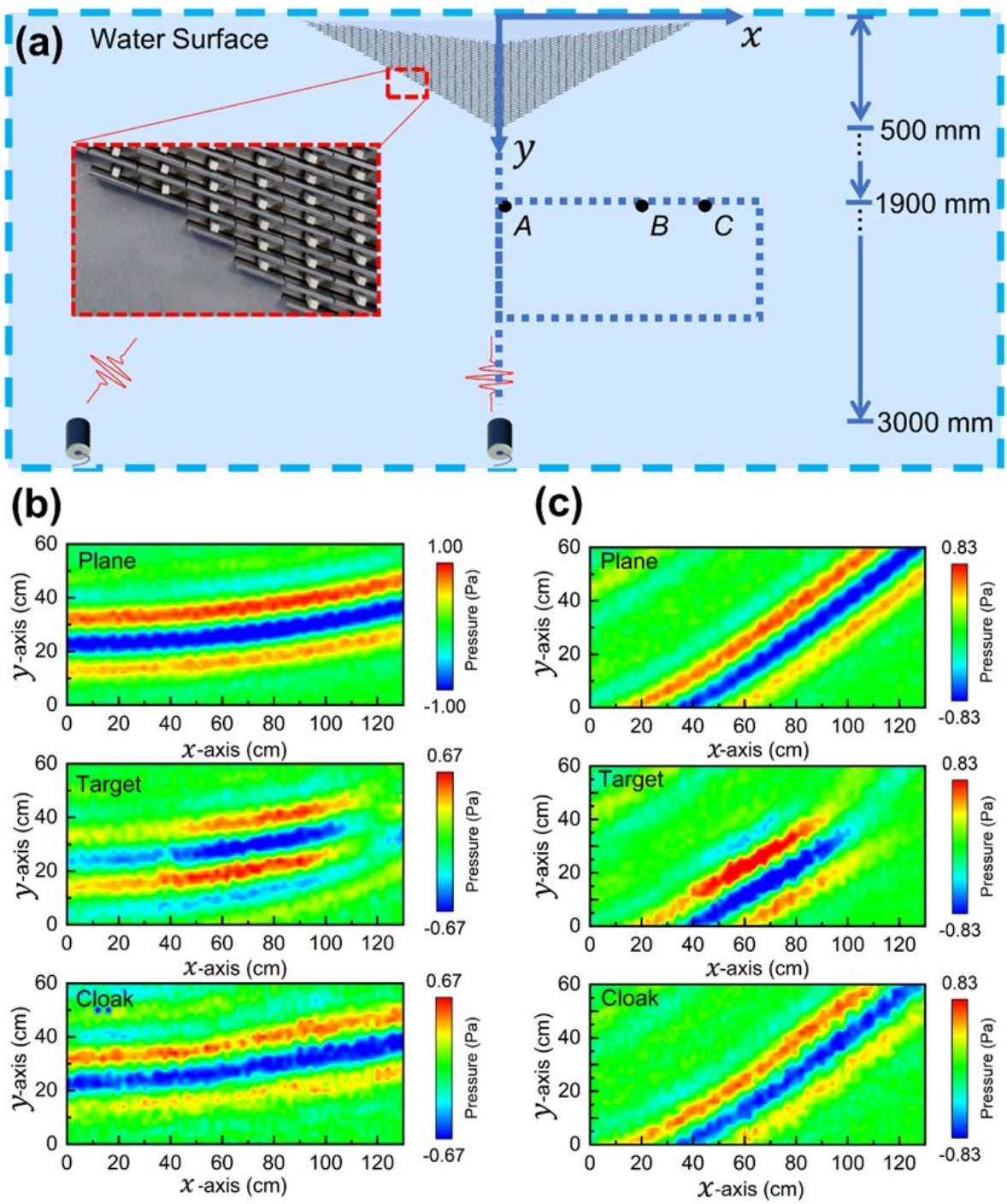

Fig. 2 Experimental demonstration of the underwater acoustic carpet cloak. Credit: IACAS

By periodically embedding the syntactic foam and steel rods in water, they designed and prepared a two-dimensional underwater acoustic carpet cloak. The experiment demonstration was conducted in an anechoic water tank. Experimental results indicated that the designed carpet cloak worked well under both normal and oblique incidences with broadband frequencies.

Moreover, the introduction of syntactic foam in the design of the carpet cloak provides an extra degree of freedom for the acoustic parameter regulation of the metafluid in underwater acoustic devices.

More information: Ping Zhou et al, Underwater Carpet Cloak for Broadband and Wide-Angle Acoustic Camouflage Based on Three-Component Metafluid, *Physical Review Applied* (2022). DOI: 10.1103/PhysRevApplied.18.014050

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