Materials scientists devise window that mutes sound but allows air to pass through

July 9 2013, by Bob Yirka

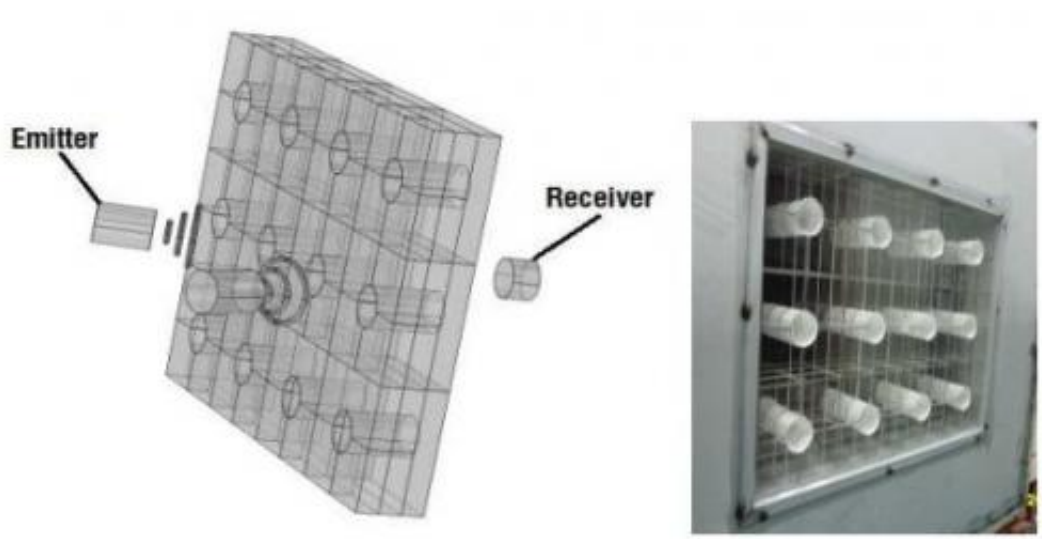

Diagram and picture of the measurement of the 50mm window.Credit: arXiv:1307.0301 [cond-mat.mtrl-sci]

(Phys.org) —A team of materials scientists in South Korea has created a type of window that mutes noise while simultaneously allowing air to move through. In their paper they've uploaded to the preprint server *arXiv*, the team describes their window and how it was constructed.

To prevent noise from passing from one place to another, engineers generally use types of material that are able to transfer sound in the air to another medium, which then weakens its force (attenuation). For that reason, it would seem impossible to create a medium that would allow

sound carrying air to pass though, while muting the very sound its carrying. But that's what the team in Korea has accomplished.

The window, is not actually a window, instead it's two parallel planes of clear plastic separated from one another by a mere 40 millimeters—similar to double paned glass. The chamber between the plastic planes has been designed in such a way as to ensure that sound that enters is counteracted by the pressure in the chamber—using a principle known as bulk modulus (a materials' resistance to compression.) Each chamber is "roughly" 150 millimeters square—to create a larger window the chambers were arranged in an array.

The double pane approach muted sound, but not nearly as much as most would like. To cause more muting the team placed cylinders made of clear plastic through the planes (which they call emitters and receivers)—each with a piece of flat clear plastic covering both ends. A hole was then drilled through the flat plastic pieces allowing sound carrying air to pass through. As it did so, the sound was diffracted into the chamber between the two planes. The reason a cylinder was used instead of just drilling a hole in the plane was for allowing a filter to be placed to prevent the air passing through from whistling. The result is a window, or venting system, that allows for air passage while muting sound. Testing of the window showed it able to reduce sound by 20 to 30 decibels.

The researchers note that changing the size of the hole allows for muting different frequencies. This they say could lead to interesting scenarios, such as a venting system that would mute annoying noises while allowing desired noise (such as waves on a beach) through along with fresh air.

More information: Air transparent soundproof window, arXiv:1307.0301 [cond-mat.mtrl-sci] arxiv.org/abs/1307.0301

Abstract
A soundproof window or wall which is transparent to airflow is presented. The design is based on two wave theories of diffraction and acoustic metamaterials. It consists of a three-dimensional array of strong diffraction-type resonators with many holes centered at each individual resonator. The acoustic performance levels of two soundproof windows with air holes of $20mm$ and $50mm$ diameters were measured. Sound waves of 80dB in the frequency range of $400 - 5,000Hz$ were applied to the windows. It was observed that the sound level was reduced by about $30 - 35$dB in the above frequency range with the $20mm$ window and by about $20 - 35$dB in the frequency range of $700 - 2,200Hz$ with the $50mm$ window. It is an extraordinary acoustic anti-transmission. The geometric factors which produced the effective negative modulus were obtained.

Found on Arxiv Blog

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