Carbon Nanotube Speakers Could Be Powered by Lasers, Transform Noisy Spaces into Peaceful Sanctums

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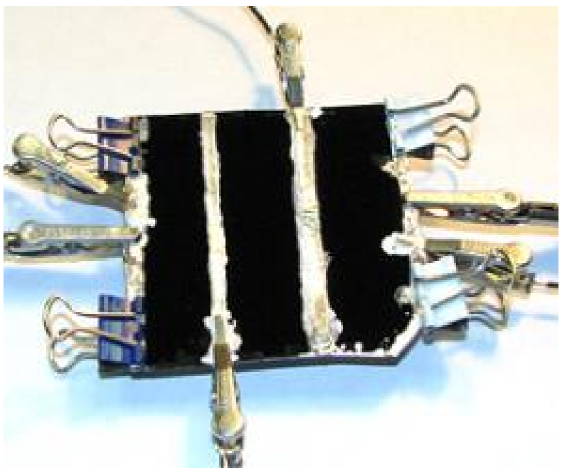

The nanotube device uses a principle first identified by Alexander Graham Bell.

(PhysOrg.com) -- A UT Dallas team's study published in the *Journal of Applied Physics* expands the extraordinary capabilities of nanotechnology to include laser-powered acoustic speakers made from assemblies of carbon nanotubes.

The study confirms earlier research that carbon nanotubes that are stretched into sheets and electrically powered can produce intense sound, but researchers at UT Dallas' Alan G. MacDiarmid NanoTech Institute have made some important advancements.

Although prior studies demonstrated that sheets of carbon nanotubes can produce sound when heated with alternating electrical current, the UT Dallas researchers have found that striking tones can be generated by vertical arrays of nanotubes, called forests, which resemble black velvet.

The team also discovered that high-quality sound can be generated when nanotube sheets or forests are struck with laser light that is modulated, or "altered," in the acoustic frequency range.

"Nanotubes assemblies of various types are black and highly conductive," said Dr. Mikhail Kozlov, a research scientist and the study's lead author. "Their dark, conductive surface can be effectively heated with laser light or electricity to induce variations in the pressure of the air around the nanotubes — which we perceive as sound. It's called the photo- or thermo-acoustic effect, and it's the same principle Alexander Graham Bell used to produce sound on the first telephone."

With laser excitation, no electrical contact with the nanotube speaker is required, making the speakers wireless.

"Speakers made with carbon nanotube sheets are extremely thin, light and almost transparent," Kozlov said. "They have no moving parts and can be attached to any surface, which makes the surface acoustically active. They can be concealed in television and computer screens, apartment walls, or in the windows of buildings and cars. The almost invisible strands form films that can 'talk.'"

In addition to filling a room with sound from invisible speakers, nanotube speakers could easily cancel sound from the noisiest neighbor or dim the roar of traffic rushing past a neighborhood, using the same principles as current sound-canceling technologies.

"The sound generation by nanotube sheets can help to achieve this effect on very large scales," Kozlov said.

Carter Haines, a senior physics major, co-authored the journal article and assisted in putting the nanotube speakers through their paces. He is a former George A. Jeffrey NanoExplorer, who conducted research at the NanoTech Institute while in high school. He has continued to perform research in the lab as an undergraduate.

"Hands-on research like this is very important to me," Haines said. "We had to put together the test set-up from scratch. I've enjoyed tinkering with small projects on my own, but the resources and the source of direction NanoTech offers allows me to explore science on a whole different level."

In addition to demonstrating that forests and sheets of nanotubes can generate sound, the team took a number of capability measurements to add to the growing list of characteristics, or properties, scientists can use in future studies. Such characterizations are especially important in new areas of research and serve as platforms of knowledge, built layer by layer, from projects like this.

Haines expressed a sentiment familiar to all researchers upon learning the journal article had been published.

"On the one hand, it's rewarding to see something I worked on get recognized and published," Haines said. "On the other hand, I know this is just one small thing, and if anything, it serves to remind me how much more there is to be done."

More information: Paper: link.aip.org/link/?JAPIAU/106/124311/1

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