



photo courtesy of James Phillips

In this photo of a uaser, two piezoelectric transducers (top center) are attached to an aluminum block (center) that serves as a resonator – an acoustical cavity. The transducers emit and absorb acoustic waves similar to the way atoms emit and absorb electromagnetic waves.

## No WAY-zer, dude!

### UMR helps create laser of sound

The uaser (pronounced WAY-zer) may sound like something Elmer Fudd might use to “kill the wabbit,” but it’s really a twist on the classic laser.

Built by researchers at UMR and the University of Illinois at Urbana-Champaign, the ultrasound analogue of the laser produces ultrasonic waves that are coherent and of one frequency, and could be used to study laser dynamics and detect subtle changes, such as phase changes, in modern materials.

“We exploit the fact that coherence and stimulated emission are classical concepts and, as such, can be applied to build a mechanical device – uaser – a classical analogue to the laser,” says **Alexey Yamilov**, research assistant professor of physics at UMR who collaborates with Richard Weaver, professor of theoretical and applied mechanics, and research associate Oleg Lobkis at the University of Illinois at Urbana-Champaign.

To make a uaser, the researchers begin by mounting a number of piezoelectric auto-oscillators to a block of aluminum, which serves as an elastic, acoustic body. When an external acoustic source is applied to the body, the oscillators synchronize to its tone. Like fireflies trapped in a bottle, the oscillators synchronize to the frequency of the source. In the absence of an external source, the tiny ultrasonic transducers become locked to one another by virtue of their mutual access to the same acoustic system.

The ultrasonic systems with their longer wavelengths and longer time scales can permit probes and controls to a degree not possible in optics. Uasers could also serve as highly sensitive scientific tools for measuring the elastic properties and phase changes of modern materials, such as thin films or high-temperature superconductors.

## What’s in your water?

Ask a homeowner for a glass of water and you may be asked if you want ice. But in early 2004, Washington, D.C., residents learned their cool refreshment was hiding a third ingredient: extraordinarily high levels of lead.

**Jay A. Switzer**, the Donald L. Castleman/ Foundation for Chemical Research Missouri Professor of Discovery in Chemistry at UMR, was asked to study what happens when water districts switch from using free chlorine to disinfect drinking water to using monochloramine. That’s what occurred during early 2004 in Washington, D.C. Soon, officials discovered elevated levels of lead in several of the city’s homes.

“You have to disinfect drinking water to kill pathogens or to inactivate them and what has traditionally been used is chlorine,” said Switzer. “Basically they just bubble chlorine through the water and the practice has been very effective.”

Effective, but not necessarily safe. Chlorine reacts with natural organic matter in the water and some of the byproducts it makes, like chloroform, are suspected to be carcinogenic.

To reduce the carcinogens in drinking water, the EPA began exploring other disinfection options and, while not quite as effective as chlorine, monochloramine doesn’t produce harmful byproducts.

Yet Switzer’s team found that when monochloramine was added to the water, lead almost completely dissolved into the water. This could explain the lead increase in Washington’s drinking water.

While homes are rarely constructed with lead pipes today, there are still several sources of lead along the path from the water district to a kitchen tap, including service lines in older homes, flow regulators or lead-free brass faucets, that can contain up to 8 percent lead. Even the copper pipes in newer homes are soldered with lead solder.

Switzer details his research in the May 15 issue of the journal *Environmental Science and Technology*. The article is co-authored by **Vishnu Rajasekharan**, postdoctoral associate in the UMR Materials Research Center; **Sansanee Boonsalee**, graduate student; **Elizabeth Kulp**, graduate student; and **Eric Bohannon**, research assistant professor, in the UMR Materials Research Center.