New laser spectrometer opens the way for more effective carbon trading, drug development and carbon dating

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Carbon offsets increasingly are becoming a major component in the arsenal for reducing global warming. Even Bon Jovi, the Rolling Stones and the Dave Matthews Band are doing it: acquiring carbon offsets to reduce the carbon footprint of their tours. As more organizations and businesses start trading in carbon offsets, the need for accurate measurements of carbon emissions also is becoming critically important for fair and exact exchanges.

As reported in the July 1 issue of *Analytical Chemistry*, a new ultra-sensitive laser-assisted ratio analyzer (LARA) developed by Dr. Daniel Murnick, professor of physics at Rutgers University in Newark, NJ, with research associate Ozgur Dogru and graduate student Erhan Ilkmen, is capable of measuring even slight changes in carbon 14 (C-14), an isotope of carbon. By measuring small changes in C-14, it can be better determined how much carbon dioxide is being released into the atmosphere from fossil fuel burning. Additionally, the technology opens up the possibility of using non-therapeutic micro-doses in drug research processes, along with expanding carbon-dating capabilities.

Currently, measuring such small changes in C-14 requires using an accelerator mass spectrometer (AMS), which is as large as a room, expensive and requires a sample size of at least milligram. The ultra-sensitive LARA spectrometer developed by Murnick and his team fits on a laboratory bench, is easier to operate and can measure samples as

small as a tenth of a milligram.

Environmental Monitoring

C-14 is an ideal indicator for monitoring carbon emissions since it makes up such a small part of the atmosphere. By measuring tiny changes in its presence, it is possible to determine how much carbon dioxide is coming from fossil fuels and its storage time in the environment, explains Murnick. Because the LARA spectrometer can deal with a continuous flow of carbon dioxide, real-time monitoring also is possible.

Drug Analysis

C-14 is used in the early stages of drug development to determine how a drug is metabolized in the body, where it goes and whether it breaks down before it can be effective.

Because it can measure such small samples, the LARA also makes microdosing possible in the drug development process. Microdosing allows for fewer C-14 tracers and smaller drug doses while still allowing individual response to be determined.

"Due to the expense and complexity of AMS technology, it is not often used at present," explains Murnick. "What we have invented is a way to make high sensitivity measurements with small sample sizes routine in the drug development process."

Carbon Dating

Along with its potential applications in drug testing and environmental monitoring, the spectrometer also can provide for enhanced carbon

dating.

In carbon dating, the age of organic remains is determined by measuring the amount of C-14 remaining since the death of the organism. Current techniques, however, require a relatively significant sample size to date them.

"In archeology, the finds are often very small samples and sometimes too small to allow for traditional carbon dating," says Murnick. "Our equipment can eliminate that problem. We also hope to eventually miniaturize the equipment so it can be used on site."

Rutgers has applied for a patent for the LARA technology. Rutgers currently holds 12 patents for technology developed by Murnick, including laser-based equipment he has developed for detecting C-13. Included among those inventions is a laser-assisted ratio analyzer breath test system that detects the bacterium that causes most stomach and intestinal ulcers, which was presented with a Thomas Alva Edison Patent Award by the Research and Development Council of New Jersey.

Source: Rutgers University