Turning a nuclear spotlight on illegal weapons material

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Researchers at the National Institute of Standards and Technology (NIST) and Oak Ridge National Laboratory (ORNL) have demonstrated that they can cheaply, quickly and accurately identify even subnanogram amounts of weapon-grade plutonium and uranium. Their work was presented in September at the national meeting of the American Chemical Society.

Worldwide, most nuclear facilities generate electricity or produce neutrons for peaceful research--but they also can create materials for nuclear weapons. International inspectors routinely tour such facilities, taking cloth wipe samples of equipment surfaces for forensic analysis of any potential weapon-grade materials in suspicious locations. In particular, they search for specific uranium or plutonium isotopes capable of setting off a nuclear explosion.

NIST chemists working at the NIST Center for Neutron Research have applied a highly sensitive technique called delayed neutron activation analysis to improve such efforts, the NIST and ORNL researchers report. The center includes a specially designed research neutron source, which bathes material samples with low-energy neutrons. Next, those samples rapidly go into a barrel-shaped instrument, embedded with neutron detectors, which precisely count the neutrons emitted over a short period of time. The neutron count acts as a unique signature of special nuclear material. In their study, the scientists used this technique to successfully identify trace amounts of uranium-235 and plutonium-239 in less than three minutes.

"We're emphasizing the technique now because world events have made it more critical to detect traces of nuclear materials, which is technically very challenging," says analytical chemist Richard Lindstrom, co-author of the ACS presentation. This tool also complements a variety of other sophisticated methods used by NIST researchers working on homeland security.

The low detection levels are due in part to the use of the NIST neutron source, which is particularly well designed for this task. The technique can detect weapon-grade material just four microns in diameter - less than a tenth the size of a human hair. The technique could be used to find subtle, lingering radioactive material in samples taken during inspection of trucks or cargo shipping containers, for instance. Beyond forensics, NIST uses the technique for measurements of isotopes in research and for industrial projects. The team is now working to automate the counting instrument and simplifying its operation for rapidly handling large batches of samples.

Citation: R. M. Lindstrom, D.C. Glasgow and R.G. Downing. Trace fissile measurement by delayed neutron activation analysis at NIST. Presented at the 232nd ACS National Meeting, San Francisco, Calif., Sept 10, 2006.

Source: NIST