New fingerprint visualization method uses X-rays to reveal missing clues

March 14 2005

Dusting for fingerprints can sometimes alter the prints, erasing valuable forensic clues. Now, chemists say they have developed a new fingerprint visualization technique using X-rays that leaves prints intact and, in addition, reveals chemical markers that could give investigators new clues for tracking criminals and missing persons. Their technique was described today at the 229th national meeting of the American Chemical Society, the world's largest scientific society.

The technique could be especially promising for tracking down missing or lost children, according to the researchers. Children's fingerprints are often more difficult to detect than adult's. The new method could detect prints based on chemical markers left behind in the child's fingerprints due to the presence of food, soil or saliva that can be used to track down evidence of the child's movements, the scientists say.

Traditional fingerprinting methods involve treating samples with powders, liquids or vapors to add color to the fingerprint so it can be easily photographed, a process called contrast enhancement. But fingerprints present on certain substances such as fibrous papers, textiles, wood, leather, plastic, multi-colored backgrounds and human skin can sometimes be difficult to detect by this method, according to study leader Chris Worley, Ph.D., an analytical chemist with Los Alamos National Laboratory in New Mexico. Besides permanently altering the prints, developing an effective visualization method can sometimes be time consuming, he adds.

The new technique uses a process called micro-X-ray fluorescence (MXRF), which rapidly reveals the elemental composition of a sample by irradiating it with a thin beam of X-rays without disturbing the sample. Salts such as sodium chloride and potassium chloride excreted in sweat are sometimes present in detectable quantities in fingerprints. Using MXRF, the researchers showed that they could detect the sodium, potassium and chlorine from such salts. And since these salts are deposited along the patterns present in a fingerprint, an image of the fingerprint can be visualized producing an elemental image for analysis.

In preliminary laboratory studies using the technique, Worley and his associates demonstrated that they could even detect fingerprints when lotion, soil, saliva or sunscreen was applied to the hands. Such prints might be difficult to detect using conventional screening methods.

“This process represents a valuable new tool for forensic investigators that could allow them to nondestructively detect prints on surfaces that might otherwise be undetectable by conventional methods,” says Worley. “It won’t replace traditional fingerprinting, but could provide a valuable complement to it.”

Unlike traditional methods in which fingerprints can often be photographed at the crime scene, the new technique currently requires that samples be taken to the lab for analysis with the MXRF instrument and placed in an X-ray chamber, where a digital elemental image is collected on a computer and saved for analysis. If further testing and refinement prove successful, the experimental technique could be used commercially for fingerprint visualization in two to five years, the researchers predict.

In addition to revealing fingerprints, the MXRF technique also reveals chemical artifacts present in the prints themselves, providing new clues for crime scene analysis. Abnormally high levels of potassium, for

instance, may suggest the presence of potassium nitrate, a component of explosives. High levels of sulfur and potassium may suggest gunpowder. Other elements could reveal environmental clues, such as soil type and food particles, that help track a suspect's movements. Even partial prints that cannot be used to identify a person might contain chemical artifacts that reveal useful crime clues, he says.

The technique does have limitations, Worley says. Some fingerprints will not contain enough detectable material to be "seen." In addition, MXRF fingerprint visualization can't detect every element. In general, the heavier the individual element, the more easily it is detectable by this method, Worley says. Lighter elements like carbon, nitrogen and oxygen can't be detected, but heavier elements like sodium, potassium and chlorine are more easily identified.

But in the future, the researchers hope to integrate other spectroscopic methods besides MXRF that can detect complex molecules in addition to elements, giving more complete forensic information. They also hope that their work will lead to a smaller, portable MXRF device that can be easily carried by forensic investigators to quickly test samples directly at the crime scene. More studies are planned, they say.

Besides Worley, other Los Alamos investigators involved in this study include Sara S. Wiltshire, Thomasin C. Miller, George J. Havrilla and Vahid Majidi.

Source: American Chemical Society