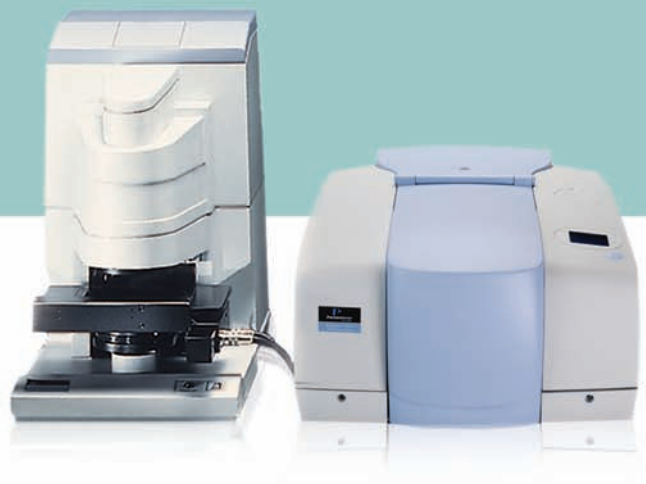
CASE STUDY

Infrared Microscopy and Spectroscopy



Moving IR Spectroscopy Down to the Micron Level Puts Serial Killer Behind Bars

Infrared microscopy played a key role in putting the United States' most prolific serial killer ever behind bars. The killer had originally been arrested based on a DNA match but the circumstances raised questions as to whether that evidence would be enough to convict. Infrared microscopy provided a crucial additional link between the killer and his victims. The new evidence quickly led to a confession of a horrific series of crimes.

On August 15, 1982, Robert Ainsworth stepped into his rubber raft and began to float down the Green River in the outskirts of Seattle. A few minutes later he peered into the clear waters and stared right into the eyes of a woman floating on her back just beneath the surface of the water. Seconds later he saw another barely submerged corpse of a young woman. The police officers he called to the scene later found a third body in the woods near the river. In the space of six months, three other bodies of young women were found in and around the river. Police quickly realized that a serial killer was on the loose.

Over the next several years, while investigators focused on an area in Seattle where many of the victims worked as prostitutes, many more women either disappeared or were discovered dead. Then on April 30, 1983, came a break that would, 20 years later, lead to closing the case. A prostitute's boyfriend saw her get into a truck with a customer just before it sped away. Suspicious of the customer, he gave chase but lost the truck. It was the last time he ever saw his girlfriend. Less than a week later, he spotted the suspicious truck in the same area where it had picked up his girlfriend. He followed the driver home and called the police. Police arrived at the house and spoke to the owner, Gary Ridgway, who denied having seen the prostitute. Ridgway turned out to be a happily-married family man, so he didn't fit the psychological profile developed of the killer, and he passed a polygraph test, so police crossed him off the suspect list.

PerkinElmer®
For the Better

Bodies continue to appear

Meanwhile, the bodies continued to appear in clusters in new locations around the Seattle area throughout the 1980s. Towards the end of the decade, the rate of the "Green River" killings tapered off as the number of confirmed victims approached 50. Ridgway attracted investigators' attention again during 1987. They noted that in addition to the incident mentioned earlier, he had been picked up for choking a prostitute, soliciting prostitution services from an undercover police officer, and that he had once been stopped and questioned with one of the victims in his truck. In addition, Ridgway appeared to have been absent or off-duty from work on every known occasion when a victim had disappeared. On April 8, 1987, police searched Ridgway's house and took saliva samples and other evidence but didn't find anything that linked him to the murders.

By 1991, the killings stopped and the case went into dormancy for a decade. Then in 2001, with DNA testing technology becoming more widespread, police began re-examining some of the evidence they had collected during the 1980s. They discovered a DNA match between Ridgway and semen taken from four of the victims. Police arrested Ridgway and charged him with murder. Ridgway's attorney planned to fight the charges by making the argument that the DNA evidence proved nothing more than that Ridgway was a customer of the women. Prosecutors were hesitant about basing their case nearly exclusively on the DNA evidence under the circumstances.

Renowned microscopist enters case

They turned to Skip Palenik, widely considered one of the world's best forensic infrared (IR) microscopists, in an effort to find additional evidence to link Ridgway with the victims. Palenik is the President and Senior Research Microscopist at Microtrace, a private laboratory specializing in the characterization and identification of single, small particles and small quantities of unknown materials. He has worked on some of the country's best known cases such as the Unabomber, Oklahoma City bombing, Atlanta child murders, JonBenet Ramsey, and many others.

Ridgway had a job painting trucks during the time when the murders occurred and investigators collected many paint samples from his car, clothes, and work locker. Many paint samples had also been collected from the victims. Palenik was asked to try to find a match.

"My first step was to use the PerkinElmer® Spectrum™ One[1] FT-IR instrument and AutoIMAGE™ FT-IR microscope to generate a unique chemical fingerprint of the several thousand paint samples associated with Ridgway that had been collected by the police," Palenik said. These samples were tiny specs that were on the order of one millimeter in size. The advantage of using an infrared microscope such as the AutoIMAGE was that Palenik could quickly examine these samples without any preparation and also without the risk of damaging them. This last point was important because any matches between the Ridgway samples and the victim samples found needed to be confirmed by other investigators and provided to the defense before they could be used as evidence in a possible trial.

Figure 1. PerkinElmer Spectrum One FT-IR System and the AutoIMAGE microscope in the Microtrace laboratory.

Matching samples against reference library

Palenik used the Spectrum software that comes with these instruments to produce a reference library of all the Ridgway samples. Once he had created the reference library, then Palenik began examining the samples associated with the victims, which looked similar with the naked eye or under a microscope. As he generated an infrared spectrum for each sample, the software immediately searched the Ridgway database looking for a match. When he found a sample with an identical chemical spectrum, he examined it using high magnification polarized light microscopy to identify the pigment and x-ray spectroscopy to determine the elemental composition. While there were a number of initial spectral matches, none of the samples held up all the way through the analysis process.

"I had completed my assignment but I had a hunch that there was a lot more to this aspect of the case than met the eye," Palenik said. "I asked the prosecutors to provide me with Ridgway's and the victims' clothing so I could take a much closer look." Palenik had previously pioneered the use of the reusable cassette-type filters originally developed to capture dust samples from air for environmental monitoring in forensic science. By connecting these filters to a vacuum cleaner, he collected particles with sizes in the 20 to 100 micron range, only about one hundredth the size of the particles he had examined in the first phase of his analysis. His hunch was based on the fact that spray painting guns, such as those used by Ridgway in his job, generate tiny spheres of paint in the micron range that are so light they float in the air rather than fastening themselves to the object being painted.

Palenik collected tiny particles and then, viewing them through a powerful optical microscope, picked them out with tungsten needles and placed them on microscope slides for analysis. The fact that no further sample preparation was required for IR microscopy was essential because it would have been difficult or impossible with samples this small. "This gets back to why I originally selected the AutoIMAGE microscope," Palenik said. "Its high signal-to-noise ratio makes it possible to generate usable IR spectra from particles as small as 10 microns by 10 microns. As the Green River investigation demonstrates, the smaller the particle you can analyze the better chance you have to solve the case. This investigation also illustrates another important advantage of this instrument. It can save huge amounts of time by automating the process of checking a sample against a reference library."

Micron-size particle matches lead to confession

"Lo and behold, we found hundreds of these tiny spheres in many colors on the clothes of six of the victims, including two that had been linked to Ridgway by DNA evidence," Palenik continued. "Most of the samples turned out to be made of Imron paint, a very rare type that was used extensively in the paint shop where Ridgway worked at Kenworth Trucks. Working with Dupont, who manufactured the paint, we were able to tie the samples to paint that Ridgway had been using around the time of the murders." Based on this evidence, prosecutors charged Ridgway with four more murders.

Figure 2. Skip Palenik, president and senior research microscopist at Microtrace.

Palenik wrote his final report in May 2003 and prepared himself to give testimony at the trial, which was scheduled to start later that year. In November 2003, shortly before the trial was to begin, Ridgway confessed to murdering 48 women. He said that these were only the ones he could remember out of a total that he estimated at 70. Even the smaller number made him the most prolific serial killer in American history. He was later sentenced to life imprisonment.

Ridgway's attorney, Tony Savage, was widely quoted in the press as saying that the paint evidence was crucial in his client's change of heart. "When this paint business came up, here you have something other than DNA – it's a particular paint you can link to Gary – and you start saying 'Well, here are seven dead women and they all can be linked to Gary one way or another,'" Savage said. "What are the odds of that happening by accident?" Palenik added that he wished he had been given the opportunity to examine the evidence 20 years earlier. "Had I looked at the evidence in the 1980s, I would have found the same paint particles. When they interrogated Ridgway in 1987 and he told them he painted trucks, they would have been able to say: 'We have some more questions for you.'"

The AutoImage Microscope System described in this case study has been superceded by the Spotlight™ 200 Automated FT-IR Microscope System and the Spectrum One by the Spectrum 100 FT-IR Spectrometer.

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com

PerkinElmer®

For a complete listing of our global offices, visit www.perkinelmer.com/ContactUs

Copyright ©2005-2009, PerkinElmer, Inc. All rights reserved. PerkinElmer® is a registered trademark of PerkinElmer, Inc. All other trademarks are the property of their respective owners.

007504A_01