GEORGIA TECH RESEARCH

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IT MUST BE MAGIC: DEVICE LINKS INFRARED SPECTROMETRY WITH LIQUID CHROMATOGRAPHY

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Researchers at the Georgia Institute of Technology and the University of Georgia have developed an invention that will allow scientists to integrate two complementary but previously incompatible methods of chemical analysis.

The Perkin-Elmer Corporation of Norwalk, Conn., and Hewlett-Packard Company of Palo Alto, Calif. will license the technology, which links an infrared spectrometer with a liquid chromatograph. In the past, scientists had no easy method for integrating these two instruments. The most commonly used alternate method, gas chromatography coupled with mass spectrometry, can't be used to analyze many organic compounds.

"There are nine million chemicals in the Chemical Abstracts Registry," said Georgia Tech Chemistry Professor Dr. Richard F. Browner. "Less than five percent of those chemicals can be analyzed with gas chromatography-mass spectrometry. By contrast, more than 95 percent can potentially be analyzed using this new device."

Invented by Browner and Dr. James A. de Haseth of the University of Georgia, the interfacing device should prove useful for analyzing pharmaceuticals, food products, and pollutants in the environment. Browner said the device will also help scientists conduct basic research to learn more about the nature of particular substances.

"This interface is useful because it lets scientists connect an infrared spectrometer with a liquid chromatograph," Browner said. "It works much like a gas chromatograph with a mass spectrometer. That is a very well-established, routine type of approach."

The device is based on an earlier invention patented by Browner and former Tech graduate student, Ross Willoughby. Known as "MAGIC" (for "Monodisperse Aerosol Generation Interface Combining Liquid Chromatography with Mass Spectrometry"), that invention was licensed to Hewlett-Packard in 1986, and has been sold commercially since June, 1988.

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Before MAGIC, scientists were usually limited to using mass spectrometry with gas chromatography because of the problems of removing liquid solvents. By first converting solvents into an aerosol, which enhances evaporation, the MAGIC device directly links liquid chromatography with mass spectrometry.

To create the new interface, de Haseth and Browner essentially re-engineered the MAGIC device to integrate liquid chromatography with "Fourier transform infrared" (FT-IR) spectrometry.

Liquid chromatography separates a substance into its individual components, while mass spectrometry provides additional clues for identifying those components. It works this way: chromatography measures traces of substances that are forced through a column packed with very fine particles. In the process, portions of the substances are absorbed, and the absorption rate provides information about the nature of the sample. On leaving the column, the substances pass into the mass spectrometer and are converted into charged ions. A traditional mass spectrometer separates substances of different atomic mass by passing them through electric and magnetic fields, thus providing data on the molecular mass and chemical type of the substances examined.

Mass spectrometry and infrared spectrometry provide very different, but complementary, types of information for identifying molecules, Browner said.

Infrared spectrometers measure portions of a molecule that interact with infrared radiation, de Haseth explained. This interaction can reveal much about the nature of the substance, including the specific combination of atoms and the position of those atoms, he said.

"Infrared spectrometry can be used to identify even those molecules whose structure differs only in the geometric placement of the atoms," de Haseth said. "The technique is non-destructive, so the sample is left for further analysis by other methods. The infrared light is less energetic than visible light, and is quite harmless."

Used in conjunction with traditional mass spectrometry, Browner said, the infrared technique can provide a higher degree of certainty for identifying substances.

A domestic patent is pending to protect the new device, and foreign patents are being filed.

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