

# PIKE REFLECTIONS



## Information for Practicing Chemists and Spectroscopists

### Pittsburgh Conference 2004 See You There!

PITTCON moves north to Chicago in 2004! It should be a great show as it has been a few years since we were in the great Midwest. In the words of the PITTCON program committee "it will be an exciting exposition with exceptional technical programs, and superb short courses." PIKE Technologies will be there, of course, participating in our 14<sup>th</sup> consecutive PITTCON with several new products – we promise.

What will you see in the PIKE booth? Friendly faces, PIKE people looking forward to seeing you again and helping with your spectroscopy sampling and lots of exciting New Products!!! We promise not to disappoint you, but right now it's still a big secret. We can tell you about some new products developed in the later part of 2003 – see our *New Products from PIKE* article.

When you stop by our booth you will be eligible for a free gift from PIKE and become eligible for the grand prize. Krista has assembled a new set of fun choices for you. Then on Thursday afternoon, we will be doing the prize drawing to see who wins the special gift – a **Dell Axim X3, hand-held PC**. Good luck to you all!



As in years past, we will be located in the Spectroscopy Central group of companies for your PITTCON convenience. Our fellow spectroscopy companies are:

- **Axiom Analytical** - FTIR, NIR, UV-VIS sampling interfacing and multiplexing equipment – Booth 3969.
- **Coblentz Society** – Fostering the understanding and applications of vibrational spectroscopy – Booth 4076.
- **Control Development** – Manufacturers of optical spectrographs, detector heads and fiber optic accessories – Booth 3972.
- **FDM Spectra** – FTIR spectral data bases. Booth 4073.
- **FTIR.com** – FTIR solutions by design. Booth 3976.
- **High Pressure Diamond Optics** – Diamond anvil cells. Booth 4074.
- **Infrared Associates** – Detectors for FTIR analysis. Booth 4072.
- **Infrared Analysis** – Gas cells, reference spectra and gas analysis software. Booth 3974.
- **Molecular Microspectroscopy Laboratory** – Developing the field of molecular microspectroscopy through basic and applied research. Booth 4071.
- **MTEC** – Photoacoustic detectors. Booth 4075.
- **Optometrics** - Manufacturer of optical components and instruments. Booth 3975.
- **PIKE Technologies** – Accessories for vibrational spectroscopy – Booth 4069

### New Products from PIKE Technologies

It's been a busy year here at PIKE Technologies and we have added some products to expand our tools for your spectroscopy sampling. Very briefly, we will highlight four of these new products. If you would like more information about any of these products, please contact us by phone, e-mail or via our web site.



4X and 6X Beam Condensers are now available for transmission analysis of samples in the range of 1 mm in size. FT-IR spectrometers typically have a beam

diameter of about 8-10 mm. Without the use of a beam condenser, the analysis of small samples, less than 1 mm in size, is very difficult and time consuming. An especially useful option for the beam condensers is the Diamond Anvil Cell. With this option we can flatten the sample and help produce a high quality spectrum.



Three reflection ATR plates are now available for the MIRacle in the Diamond and ZnSe crystal type. The MIRacle uses pre-aligned, pinned-in-place crystal plates and changing between single reflection for qualitative analysis and multi-reflection plates for analysis of minor components is quick and easy.



PIKE Technologies has added some new versions of its mid-IR integrating sphere. One of the new versions of the mid-IR integrating sphere is a variable angle option where you can optimize the angle of incident radiation for special studies. This accessory is useful for quantitative measurement of diffuse or specular reflection from samples. Some of the typical applications for this include: measurement of surface reflectivity, measurement of thermal characteristics of coatings and materials, and measurement of material composition in combination with surface properties.

Canine Play Toy Analyzer

Annie likes to be a part of the team and discusses the market opportunities for a new play toy analyzer with Irene. Annie is making her case for the big increase in pet toy manufactures and she is convinced that our spectroscopy sampling tools will help the industry bring even more play toys. Irene asks for the marketing plan. Annie says, "if you build it they will come". What do you think?



**Analysis of Skin by Attenuated Total Reflection**

**Introduction**

According to medical journals, the skin is considered the largest organ of the human body and provides many different functions. The skin provides temperature regulation, physical protection for the body, metabolic function and sensation – key to our daily survival and quality of human interaction<sup>1</sup>. The degree for which the skin can provide these important functions is related to its health and composition. The health care industry offers a large variety of treatment and medication products which are applied directly to the skin for improvement of our overall health and vitality.

Attenuated total reflection (ATR) is an ideal technique to measure the compositional effects of these treatments at the outermost, epidermal surface of the skin due to the relatively thin depth of penetration of the infrared beam into a sample when measured by ATR<sup>2,3</sup>. Special considerations for the ATR measurement include selection of a high sensitivity, high throughput accessory to measure minor differences in the skin samples.

**PIKE Technologies Celebrates 15th Year**



**2004**

is a big year for PIKE Technologies as it marks our 15<sup>th</sup> Anniversary. Started in the basement of their home on September 19, 1989, PIKE was established by Phil and Irene Brierley (pictured above) to provide creative and innovative FTIR accessories at prices customers worldwide can afford. From these humble beginnings, PIKE has consistently delivered on this promise and is coming off its biggest sales year ever. From the development of our first ATR accessory in 1989, today PIKE has over 1000 standard products and has expanded from FTIR to providing accessories for any molecular spectroscopy technique.

With over 100 dealers, PIKE products can be found all over the world serving government, academics, petrochemical, forensic, pharmaceutical, semiconductor, agriculture, automotive and the material science industries, just to name a few. Irene, and all of us at PIKE, would like to take this opportunity to say "MANY THANKS" to our customers and business partners who have made it possible for us to celebrate this 15<sup>th</sup> Anniversary in business. Beginning at PITTCON in March and highlighted in September with an open house party, keep your eyes open for a number of special surprises during this year as part of our celebration.

Furthermore the design of the ATR accessory must accommodate the relatively large, typical skin surface samples we wish to measure (forearm, palm of hand).

**Instrumentation**

The ATR is an Out of Compartment design (shown in Figure 1) where the horizontal plane of the ATR crystal is above the level of the surface of the FTIR spectrometer. This design provides an easy interface for the relatively large skin sample to be positioned flat on the ATR crystal without any restriction in its size. A flat plate crystal holder is selected to ensure good physical contact of the skin with the ATR crystal. The PIKE Technologies Out-of-Compartment ATR provides 10 reflections of the IR beam within its crystal to maximize the response from low concentration, skin treatment components of the samples. This

accessory is a high performance design with high throughput relative to the open beam of the FTIR. High throughput is important as it reduces analysis time and improves spectral quality.



**Figure 1.** Out-of-Compartment ATR used for Skin Analysis

Flat plate ATR crystals of zinc selenide (ZnSe) or germanium (Ge) were used for all measurements. Using the ZnSe crystal at 45 degree angle of incidence we achieve about 2.0 micron depth of penetration of the IR beam into the skin. With Ge in the same configuration the depth of penetration is about 0.5 microns.

**Measurement Parameters**

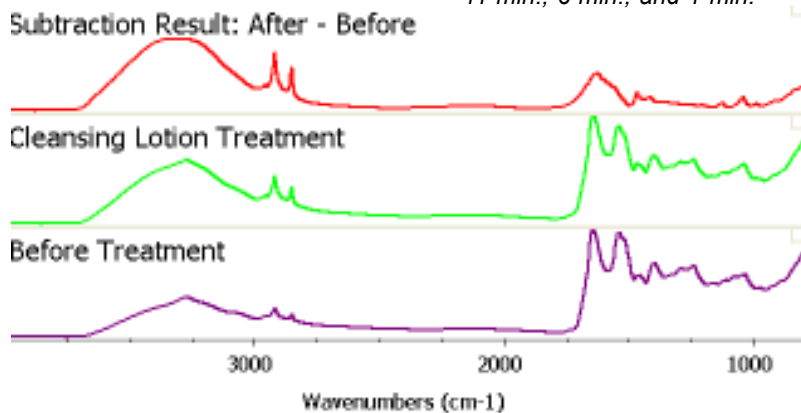
All spectra were collected at 8 cm<sup>-1</sup> spectral resolution using a 30 second data collection time. Human forearm was placed upon the flat plate ATR crystal and held stationary during the sample collection time. Background spectra (ATR accessory with clean crystal installed) were collected before each sample spectrum. The ATR crystal was wiped clean with soft cotton cloth with 70% isopropanol after each sample.

**Sample Preparation**

Skin treatment materials were applied and thoroughly rubbed into a human forearm. Samples were either run immediately or for kinetic measurements at intervals required for the experiment.

**Results and Discussion**

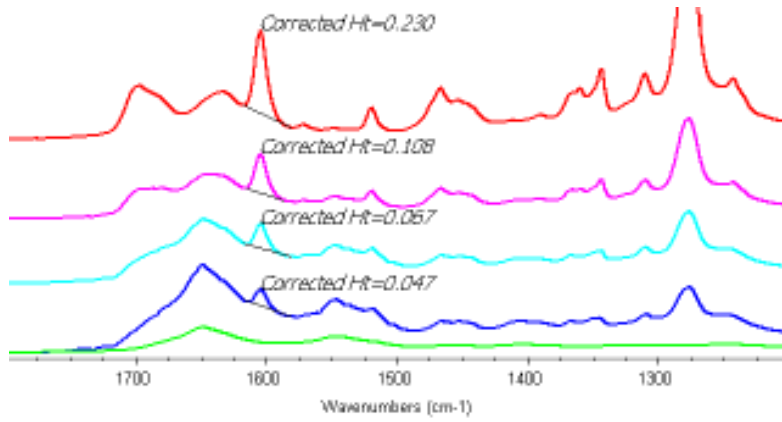
Figure 2 shows spectral results for the analysis of human skin before and after treatment with a moisturizing, cleansing product. These spectra were collected using the ZnSe ATR crystal. The lower 2 spectra (before and after treatment) in Figure 2 appear to be very similar. However, by performing spectral subtraction, we are able to see significant differences.



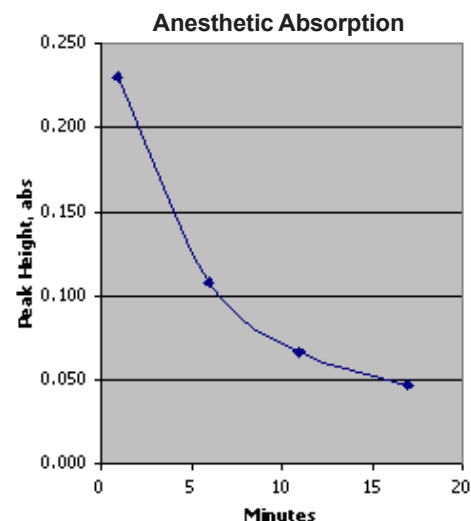
**Figure 2.** ATR spectra of skin before and after treatment. Upper (red) spectrum is subtraction result.

The upper subtraction result shows large IR bands at 3320 and 1630 cm<sup>-1</sup> demonstrating the increased skin moisture after treatment. The IR bands in the region of 2900 and between 1500 and 900 cm<sup>-1</sup> show the added hydrocarbon content from the skin treatment. These measured differences in the skin composition can now be correlated with observed differences in product performance.

Figure 3 shows spectral results for the kinetic analysis of human skin treated with a local anesthetic where sample spectra were collected at times of 1, 6, 11, and 17 minutes after application to the forearm. The Ge ATR crystal was used for this measurement to enhance the changes at the outermost layer of the epidermis. The active ingredient of this medication, benzocaine exhibits a clearly differentiated band at 1604.5 cm<sup>-1</sup>, without the need for spectral subtraction.



**Figure 3.** Kinetic Data for Absorption of Local Anesthetic in Human Skin. Spectra from bottom to top are no treatment, at 17 min., at 11 min., 6 min., and 1 min.



**Figure 4.** Kinetics of Absorption of Benzocaine into Human Skin as Measured by ATR.

**Conclusions**

The spectral data in this applications report are of excellent quality with high signal-to-noise (SNR). This is important when one needs to perform spectral subtractions to observe the minor differences in treated skin samples, or when one must measure kinetic differences over extended time periods. The PIKE Out-of-Compartment ATR accessory provides the performance necessary to achieve this result.

**References**

1. Skin Anatomy, Lewis, Don R. Jr., MD., e-Medicine, 2003.
2. Internal Reflection Spectroscopy, Mirabella, Francis M., ed, Marcel Dekker, Inc., 1993.
3. ATR Theory and Applications. PIKE Technologies, Application Note, 0402, 2004.

Band height computations were made for all spectra and these values were input to Microsoft Excel software for review. The result is shown in Figure 4, demonstrating the kinetic absorption process.

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# PIKE

## TECHNOLOGIES

*Spectroscopic Creativity*

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Madison, WI



### Spectroscopic Creativity – Our Customers Perspective

Spectroscopy glows brightly at the University of Wisconsin Synchrotron Radiation Center (SRC) in Stoughton, Wisconsin. Here Dr. Robert Julian watches over the applications and science for IR, far-IR, and UV-VIS spectroscopy where the source originates from a synchrotron. The synchrotron produces an electron beam traveling at nearly the speed of light with output power of about 3500 watts – Wow! The source energy from the synchrotron is 100-1000 times brighter than the typical source of commercial spectrometers and permits analysis of samples not possible with the original configuration of the instrument. The SRC has over 30 beam lines for sampling measurements where their customers from around the world schedule time to do their research on products and technologies of the future. Research at the SRC is supported by the NSF under award no. DMR-0084402 and use of the SRC is provided at no cost to the users. Please visit their web site at [www.src.wisc.edu](http://www.src.wisc.edu) for more information about their development technologies or contact Bob directly at [rjulian@src.wisc.edu](mailto:rjulian@src.wisc.edu) to schedule beam time.

Bob Julian stands next to the vacuum far-IR spectrometer system on the beam line. Bob explained that PIKE Technologies helped with the concept work and optics for the design of this part of their system.

If you would like to be the subject of one of our future Spectroscopic Creativity articles, please get in touch with us at [sales@piketech.com](mailto:sales@piketech.com). Send us a paragraph or two describing how you use spectroscopy in your work and a photo of you and your laboratory. Note about how we select our articles; kind words about PIKE Technologies products receive special preference for publication and a special gift from us too. We will do our best to publish your article in a timely fashion.

### PIKE 2004 Show Calendar

**PITTCON 2004** March 8-11  
Chicago, IL

**ACS West 2004** March 29-31  
Anaheim, CA

**ACS East 2004** August 23 -25  
Philadelphia, PA

We hope to see you at these locations. Please stop by and see what's new at PIKE Technologies and let us know how we can help solve your spectroscopy sampling challenges.

