COMPUTER DATA ACQUISITION
AND ANALYSIS TOOLS
FOR THE CHEMICAL SCIENCES

FEATURING THE FS-522 WITH *FASTSpec*™
LAB INTERFACE, ASSOCIATED SENSORS
AND WINDOWS BASED SOFTWARE

E-Newsletter

November 2010

Volume I, Number 4I,

In This Issue

Summer Workshop at Montana State: "Integrating Computers into Laboratory Instruction: Balancing Content, Inquiry Skills, and Increasing Enrollment." Dates TBA soon.

We will once again be offering a two and a half day workshop in the summer of 2011 at Montana State University, Bozeman, MT, for faculty in the chemical sciences. Participants in this hands-on conference and workshop will work together with national leaders in chemical education to explore, practice, and evaluate new instructional strategies and the use of computer technologies to improve learning; to use

Spectroscopy with MicroLab: Using Our Patented *FASTSpec*™ Technology to Save Money, Save Time, Learn More!

This issue of the MicroLab newsletter is the first of several in which we hope to stimulate your thinking about how the MicroLab FS522 lab interface with its built-in, patented *FASTSpec*™ spectrometer can completely replace your old, clunky colorimeters - you know the ones we are talking about - and filter fluorometers. We will discuss how it can even sit in for your high end diode array spectrometer for many quantitative and qualitative applications in lab, eliminating scheduling difficulties by replacing one $10,000 instrument with many FS522 units with *FASTSpec*™ to do the same job just as well, and many other jobs to boot.

MicroLab's FS522 unit with its built-in, patented *FASTSpec*™ spectrometer serves not only as a great multipurpose lab interface for experiments involving voltage, current, pressure, conductance, pH, ISE, temperature, event counting, and timing, but also as a 360 to 940 nm spectrometer for measuring absorbance, transmittance, scattering, and fluorescence spectroscopy.

The FS522 can also serve as a cost effective replacement for expensive fluorescence UV excitation sources with USB/CCD spectrometers such as the *MicroLab/AvaSpec*

limited lab time and space more effectively; and to reduce chemical costs and increase safety. They will also have an opportunity to enjoy Montana's gorgeous Mountain West. We are still finalizing the dates, but pencil us in for July 2011!

See Us at the Upcoming Meetings Indicated Below...

191st 2YC3 Conference, Mt. San Antonio College, Walnut CA
March 25-26, 2011

ACS National Meeting Anaheim CA
March 27-31, 2011

Northwest ACS Regional Meeting, Portland, OR
June 26-29, 2011

Quick Links...

Website
Catalog
MicroLab support
See us in the ACS Buyer's Guide
MicroLab Experiments

Ideas? Suggestions? *We want to hear from you!*

If you have a question about the capabilities of the FS-522, please ask us. You may be surprised at its potential in your situation! Email us (info@microlabinfo.com) or click the MicroLab Support in the Quick Links box (above) for other contact information.

If you have an interesting

211C or the **Ocean Optics** *USB2000* running in fluorescence mode. Running both the FS522 and the USB spectrometer on the same PC, you can choose your excitation wavelength and intensity with the FS522 and MicroLab software, excite the sample and use the fiber optic adapter to guide the emission to the USB spectrometer to measure the fluorescence emission spectrum with the USB spectrometer software. *Voila*! You now have most of *the features of a true spectrofluorometer* - you can analyze emission intensity as a function of concentration at a given excitation energy/intensity, or you can see immediately the effect on the emission spectrum of changing the intensity and/or wavelength of the excitation source. No more filters. No more hydrogen lamps. For more details, download a catalog by clicking on the link in the Quick Links to the left of this panel and down a bit.

Let's Get Technical!

The 16-bit precision of the FS522 with *FASTSpec*™ translates to 1 part in 65,000, 16 times the resolution of 12-bit instruments, which means, practically speaking, a solid extra decimal point in your results. For the *FASTSpec*™ this means far better reproducibility in absorbance (less than ±0.0002 a.u.), transmittance, and fluorescence measurements than we are used to seeing in our spectrometers.

Of course, there is more to instrument reproducibility than bits: AC noise, variations in the source intensity, and sample heating via the source lamp through open shutters are big sources of poor reproducibility in spectroscopy. With MicroLab's patented *FASTSpec*™ you can essentially forget about these. MicroLab's digital signal processing circuitry virtually eliminates AC background noise. In addition, each LED source is pulsed with a digitally controlled current regulator, so that each LED comes on at exactly the value pre-set in acquiring the blank, and it stays on for less than 0.1 sec during data acquisition, so there is no sample heating or intensity drift. Since the sample compartment is dark except during the time the LED is on, there is no need for a shutter: no shutter, no sample heating, no moving parts to wear out or break.

LEDs have an intrinsic bandwidth of about 20 nm. Absorption or emission bands of molecular materials in

application of the MicroLab system in your lab, we would love to hear from you! Send us an email - just click on the link above.
If you want to contribute a featured lab application to the E-Newsletter, please contact the editor!
mjcollins@viterbo.edu

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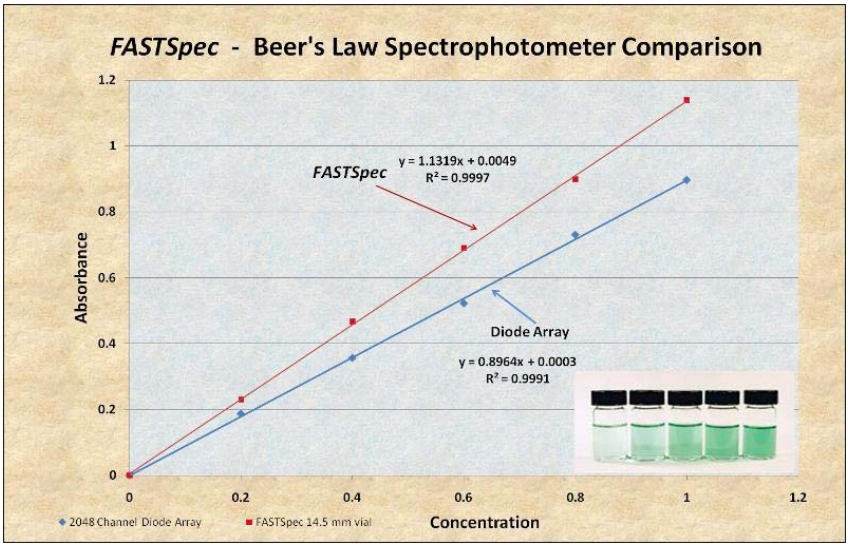
What some of our colleagues using the FS522 say:

"It used to be that students would spend a three-hour lab gathering data. Now, students can focus on what the data means; this enables them to decide quickly whether or not they need to do the experiment over. The discovery process - how the numbers relate to a concept - takes place in the lab, not when the students are writing their lab reports."
Dr. Carolyn Mottley
Luther College

"I have been using the MicroLab FS-522 in our general and physical chemistry laboratories. I am impressed with the

solution are much wider than this, typically on the order of 100 nm half width at half height. The *FASTSpec*™ spectrometer uses 16 LED's with discrete wavelengths rather than a continuous source, but because of the smooth nature of molecular absorption and fluorescent emission bands, any absorption or emission band from 360 to 940 nm can be used to analyze substances easily and accurately with the *FASTSpec*™ spectrometer. Quantitative results are excellent. Beer's Law plots with *FASTSpec*™ have linearity that compares with those obtained with the best diode array spectrometers and polished glass cuvets, as illustrated in the figure below.



Comparison of the Beer's Law plots obtained with the FS522's *FASTSpec* and a diode array spectrometer. The different slopes are due to different path lengths.

MicroLab's LED/photodiode digital technology also means no more expensive bulb replacements, phototube swapping, or tiny red filters to find, lose, or break. And, since the *FASTSpec*™ is built in to a multipurpose lab interface, you also save storage space and setup time.

in coming issues we will explore various spectroscopy applications of the FS522 with *FASTSpec*™, including photometric titrations, fluorescence analysis, kinetics, and color mixing. In this issue we will examine an online colorimetry tutorial and a Beer's Law application.

versatility and the low cost of this interface, it opens new possibilities for experiments."
Dr. David Saiki California State University Bakersfield

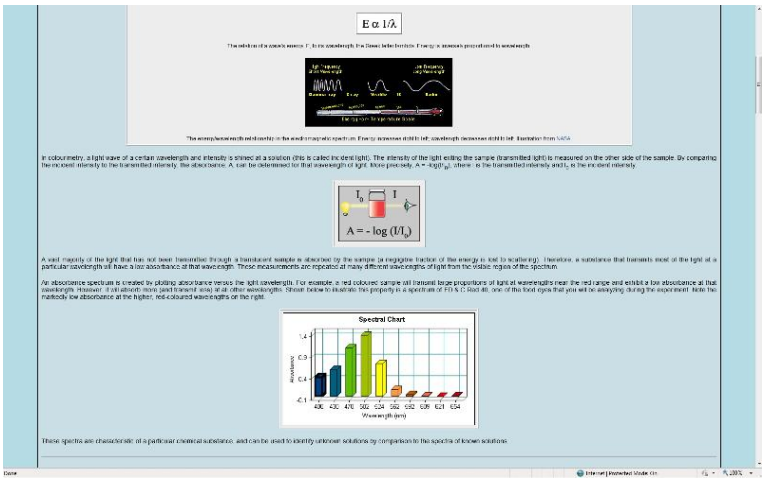
"MicroLab's software is an enormous aid for non-major students to visualize data collection in real time, and leads them to clearly understand the concept of the lab."
Dr. Angie Sower Montana State University

"I'm continually amazed at the research quality data we get from MicroLab. We can do things in teaching and in under-graduate research at a small institution that we never dreamed possible."
Dr. Tom Kuntzleman, Spring Arbor University

"You have an exceptional product. Money is very tight, and I wouldn't be spending this much of it if I didn't think that the MicroLab units were the best such devices on the market. I think that

Online Colourimetry Tutorial Featuring MicroLab's *FASTSpec* Colourimeter

No, those are not typos in the headline. It is the Queen's spelling that is used in a very nice introduction to colorimetry that has been developed through Carnegie Mellon University and the University of British Columbia, and presented here with permission of its developer, Sophia Nussbaum. A sample screen shot is shown below.



It is suitable for first year students through students in analytical chemistry, though US readers should be cautioned that it uses the Canadian spelling of colour throughout. Think of that as an opportunity to enhance cultural awareness among your US students -- for free! -- as they learn about the principles of spectroscopy in analysis.

It includes the topics

- "Why Use Colourimetry?"
- "How Does Colourimetry Work?"
- "Proper Experimental Technique"

and also has a series of questions and accompanying informative illustrations and photos. CLICK HERE to visit.

Colorimetric Determination of Iron Using Beer's Law with the *FASTSpec* Colorimeter

The standard method for colorimetric iron analysis has been around

they will transform and reinvigorate the way we teach chemistry at Oglethorpe."
Dr. Keith Aufderheide
Oglethorpe University

"MicroLab has given us a great step forward in the Physical Chemistry lab."
Dr. Clemens Heske
The University of Nevada Las Vegas

"We used the built-in spectrophotometer to study the absorption/ transmission properties of different food dyes. The students really took to the graphs produced for transmittance and absorbance ... they all said it made the ideas we were talking about really clear to see the two graphs."
Dr. "Skip " Wiley
Middlesex Community College

for years. (See for instance E. B. Sandell, *Colorimetric Determination of Traces of Metals, 3 Ed*, Interscience Publishers, Inc., New York, 1959; L. G. Saywell, B. B. Cunningham, "Determination of Iron: Colorimetric o-Phenanthroline Method"**,** *Ind. Eng. Chem. Anal. Ed.*, **1937**, *9* (2), pp 67-69.) The chemistry involved is to convert Fe in the sample to a soluble form and then reduce it to Fe(II) with hydroxylamine in a solution buffered to keep the pH around 8, usually with a solution of sodium acetate or sodium citrate. This is followed by the addition of 1,10-phenanthroline, often abbreviated *o*-phen, a neutral bidentate aromatic amine ligand.

The resulting $[Fe^{II}(o\text{-phen})_3]$ complex has a broad absorption band

with a molar absorbance of ~11,000 $M^{-1}cm^{-1}$ at its peak wavelength of *ca.* 510 nm. The intensely colored complex allows Fe to be analyzed readily in the mg/L range with good accuracy and precision.

MicroLab's spectroscopy software is designed with four screen tabs corresponding to the four-step logic of a Beer's Law analysis: (1) obtain a reagent blank spectrum; (2) obtain the spectra of a series of knowns and plot absorbance as a function of concentration at a selected wavelength; (3) apply a curve fit to obtain the relationship between absorbance and concentration; (4) determine the concentration of one or more unknowns by measuring their absorbance and applying the equation of the fit line.

The figure below shows the opening screen of the MicroLab software for a Beer's Law experiment. The blank sample is placed into the sample compartment and the blank is obtained with the digital current regulator adjusting the LED intensity at each wavelength to a specified detector output.

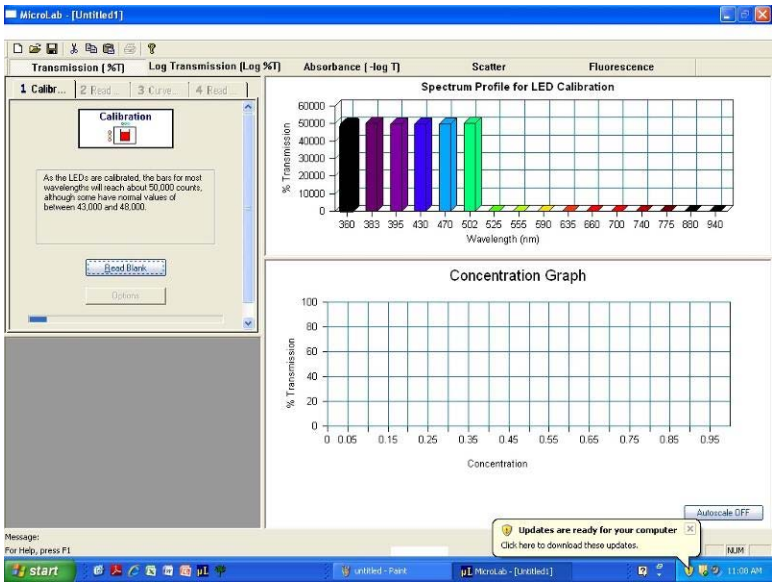


Figure 1 FASTSpec colorimeter screen shot showing blank acquisition in progress.

Next, the user is taken to the second tab and prompted to add a known and label it with a name and a concentration in arbitrary units. In the screen shot below for the analysis of Fe the concentration units are mg/L Fe. Each sample is added to a Beer's Law plot at any of the 16 wavelengths so the user can see the standard curve as it develops. The user can change wavelengths at any time to see a new plot at that wavelength. In the figure below, the plot is for the data at 470 nm. Note the relation among the wavelength, the color of the absorbance bar, and the color of the points in the calibration line. Subtle cueing to the student of the relationship between wavelength and color is uniquely built in to the MicroLab software. Another feature allows the user to remove standards or replace an entry during this phase of the experiment.

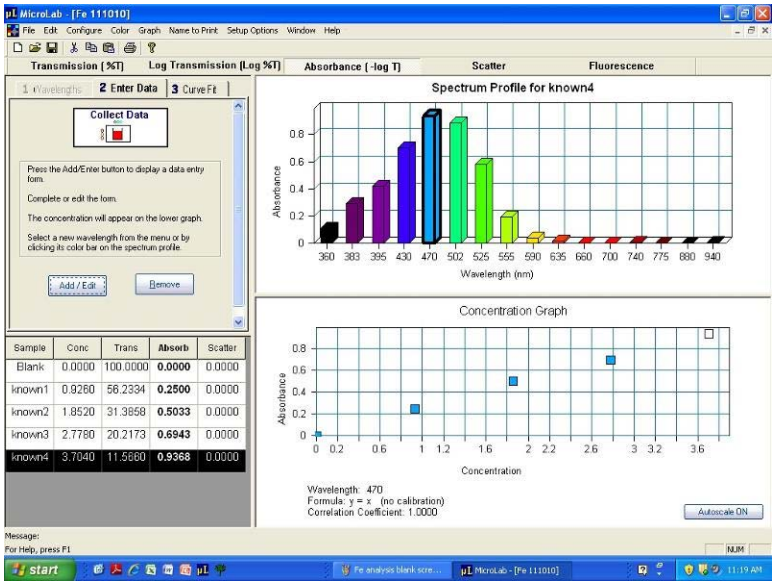


Figure 2. Standard curve for iron analysis at 470 nm.

The third tab allows the user to add a curve fit to the plot to obtain the relationship between absorbance and sample concentration. The user can choose first order through fourth order as well as exponential fits. The data shown have had a linear fit imposed.

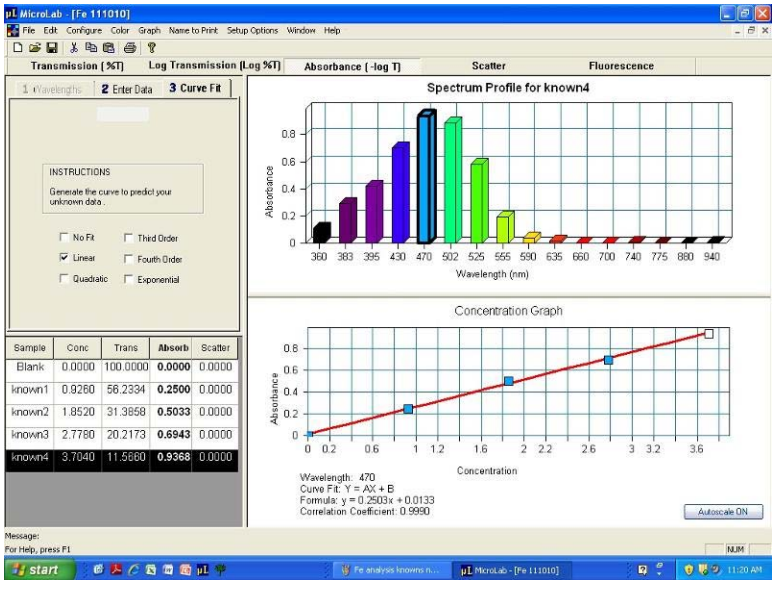
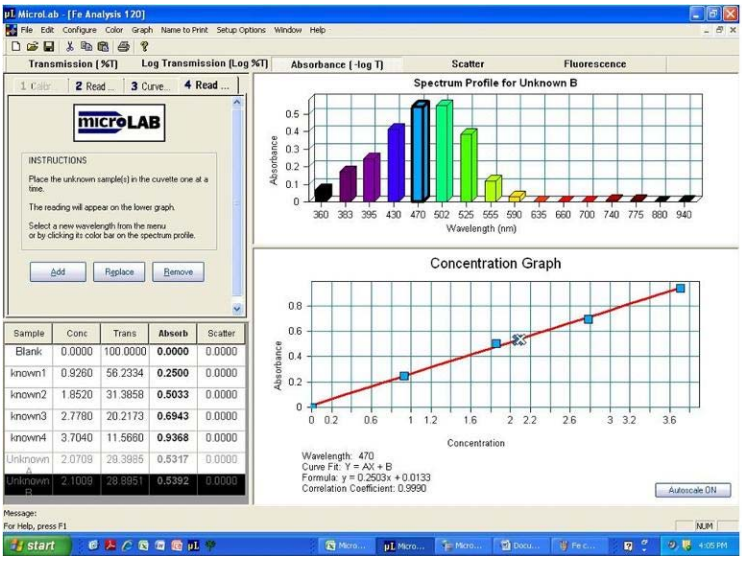


Figure 3. Calibration curve with linear fit added. The software inserts the user-selected curve type and the best equation for the curve.

The fourth tab in the software allows an unlimited number of unknowns to be analyzed from the standard curve. The software

places each sample's result on the standard curve with an "X" and places the computed concentration in the spreadsheet.

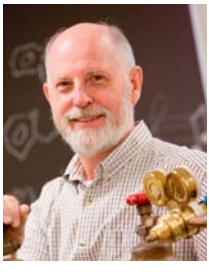


Sample	Conc	Trans	Absorb	Scatter
Blank	0.0000	100.0000	**0.0000**	0.0000
known1	0.9260	56.2334	**0.2500**	0.0000
known2	1.8520	31.3858	**0.5033**	0.0000
known3	2.7780	20.2173	**0.6943**	0.0000
known4	3.7040	11.5660	**0.9368**	0.0000
Unknown A	2.0709	29.3985	0.5317	0.0000
Unknown B	2.1009	28.8951	0.5392	0.0000

Figure 4. Screen shot showing unknown iron samples as "X"s superimposed on the calibration curve. The program also displays the computed Fe concentration of each in the spreadsheet.

As I will illustrate in the next newsletter, one can also use features of this same software to perform microliter photometric titrations right in a stirred sample vial and use the "Beer's Law plot" feature to generate the titration curve. MicroLab's software design makes it easy to carry out precise routine measurements, but it also allows you to use your imagination to do other cool stuff.

Meet the Editor: Michael Collins



Michael Collins is Emeritus Professor of Chemistry at Viterbo University in La Crosse, WI, USA. He taught undergraduate chemistry for 38 years at virtually every level - from introductory chemistry for liberal arts, nursing, pre-med, biology and chemistry majors to advanced courses for senior chemistry and biochemistry majors. He was the 1988 CASE Wisconsin Professor of the Year and has won awards at Viterbo for his scholarship, teaching, and service. He has been active in his local American Chemical Society section, and chaired the planning committee for the Great Lakes Regional Meeting that was held in La Crosse.

His interest in computer data acquisition began in the early 1980s, and he became convinced of its ability to enhance the lab experiences of his students as well as to prepare them to function in a

modern lab setting. He has developed experiments across Viterbo's curriculum that use MicroLab for guided inquiry experiments as well as for more routine data logging and analysis. He has also given presentations on the role of computers in the laboratory to facilitate learning chemistry and in the assessment of lab outcomes. He has been using MicroLab products since they first arrived on the scene, and he continues to develop ideas for new applications of MicroLab in undergraduate teaching and research.

Please contact us at MicroLab for more information and to learn how simple it is to put these experiments and others just as exciting into your lab classes with the MicroLab FS522 and accessories.

Thanks for reading! We invite your feedback, ideas, and suggestions. As college educators ourselves, we on your MicroLab team value your feedback.

Sincerely,

Your MicroLab team
info@microlabinfo.com