



applied spectroscopy

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APPLIED SPECTROSCOPY 2015

On the Use of Fourier Transform Infrared (FT-IR) Spectroscopy and Synthetic Calibration Spectra to Quantify Gas Concentrations in a Fischer-Tropsch Catalyst System

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One possible origin of prebiotic organic material is that these compounds were formed on Fischer-Tropsch-type (FT) reactions of carbon monoxide and hydrogen to silicate and oxide grains, in warm, aqueous, acidic, to investigate the possibility, an experimental system has been used to simulate the efficiency of different grain-grain reactions. In this system, the gas phase above these grains is exposed to a surface using Fourier transform infrared (FT-IR) spectroscopy. To provide quantitative estimates of the concentration of these gases, techniques to which high-resolution transmission infrared (HRT-IR) spectroscopy is well suited, these spectra are generated via a method that mimics the processes going on in the instrumented line of sight of the FT-IR experiment, including spectroscopy, self-absorption, and broadening due to the finite resolution. The result is a very close match between the measured and computed spectra. This technique was tested using four major gases found in the FT reaction: carbon monoxide, carbon dioxide, carbon dioxide, and water. For the ranges typical of the FT reaction, the carbon monoxide results were found to be accurate to within 1%, and the remaining gases accurate to within 10%. These spectra can then be used to generate synthetic calibration spectra, allowing the rapid completion of the gas concentrations in the FT experiments.

Indexing: Fischer-Tropsch reaction, infrared spectroscopy, FT-IR spectroscopy, synthetic calibration spectra, Fischer-Tropsch reaction, FT-IR, Calibration, Synthetic spectra.

INTRODUCTION

An important question in the origin of life is, what is the source of the necessary prebiotic molecules? In their classic experiment, Miller and Urey¹ were able to synthesize amino acids under an atmosphere of methane, ammonia, and water with an arc discharge. Unfortunately, the Miller-Urey experiment requires this type of reducing atmosphere and later research seems to suggest that the Earth's primordial atmosphere was only slightly reducing, consisting mostly of nitrogen and carbon monoxide. Other possibilities for the origin of such prebiotic material include submarine vents, but a problem with these vents is that the production rate of organic material is predicted to be too low. Comets have long been proposed as a delivery mechanism of prebiotic material to the Earth. Many volatile organic species have been detected in comets, and the first

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Dehydrated Carbon Coupled with Laser-Induced Breakdown Spectrometry (LIBS) for the Determination of Heavy Metals in Solutions

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In this article, a novel and alternative method of laser-induced breakdown spectroscopy (LIBS) analysis for liquid samples is presented, which involves the removal of metal ions from a liquid sample by a solid adsorbent using a carbon-based adsorbent, dehydrated carbon, obtained using a supercritical reaction. Using this new technique, researchers can detect trace metal ions in solutions qualitatively and quantitatively, and the drawbacks of performing liquid analysis using LIBS can be avoided. The analysis is performed on a solid surface, to achieve better performance using this technique, we modified the process of adsorption, allowing both adsorption performance and LIBS analysis. The calibration curves were obtained, and the limits of detection achieved for Cu²⁺, Pb²⁺, and Cd²⁺ were 0.75, 0.88, and 0.48 mg/L, respectively, which are better than those in the previous studies. In addition, compared to other adsorbents, the adsorbent used in this technique is much cheaper in cost, easier to obtain, and has fewer or no other elements other than C, H, and O that could result in spectral interference during analysis. We also used the recommended method to analyze spiked samples, obtaining satisfactory results. Thus, this new technique is helpful and promising for use in wastewater analysis and management.

Indexing: Dehydrated carbon, Laser-induced breakdown spectroscopy, LIBS, Heavy metals, Liquid analysis.

INTRODUCTION

Ecotoxic metals, often referred as heavy metals, are harmful to living organisms. With the rapid process of industrialization and urbanization, more and more heavy metals in various forms are being poured into the ecosystem, such as natural water and soil, introduced from mining, metal-smelting, electroplating, and other industries. This has resulted in the public's growing concern for the environment. Heavy metals can accumu-

late in the environment and be introduced into the human body through the food chain. Thus, there is an urgent need for the detection and monitoring of heavy metals in natural water and wastewater for environmental protection. Also, the removal of such toxic metals from wastewater is of great importance in practical applications. The current technologies mainly used include chemical precipitation, adsorption, and membrane filtration. Of these, adsorption is the most common approach for removing heavy metal ions from wastewater because of its high efficiency and ease of operation.¹⁻³

Laser-induced breakdown spectroscopy (LIBS), which is considered the future successor of analytical atomic spectroscopy,^{4,5} has been widely applied to the detection and quantification of trace elements in gaseous or aerosolized⁶⁻¹¹ solid¹²⁻¹⁴ and liquid¹⁵⁻¹⁷ samples. Currently LIBS is becoming increasingly acceptable as an important tool in analytical chemistry.¹⁸ Nevertheless, owing to its limitations, such as spattering, the plasma-confinement effect, and the shorter lifetime of the plasma compared to solids, the successful application of LIBS to liquid measurement is still a long way off.¹⁹ The common way to use LIBS in the determination of heavy metal ions in liquids is to remove the metal ions from the aqueous solution. As previously mentioned, adsorption has always been a popular way to remove heavy metals from solutions by a solid holder material. Up to now, many materials have been studied as adsorbents, including carbon charcoal,²⁰ porous electrodes, ultra-fine fibers,²¹ and even three-dimensional nanochannel membrane material.²² However, such adsorbents require complicated preparation procedures, and the instruments used in such procedures are expensive, which increases the operational cost. In addition, elements contained in the substrate can easily interfere with the spectra of the analytes; they are, thus, unsuitable for wide use in wastewater management. In this study, our aim was to find a common substrate to use to capture ions, especially ions such as toxic

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February 23, 2022		February 18, 2022	August 25, 2022		August 22, 2022
March 10, 2022	Video	March 8, 2022	September 14, 2022	Video	September 9, 2022
March 25, 2022		March 22, 2022	September 27, 2022		September 21, 2022
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THE LATEST SPECTROSCOPY PRODUCTS AND LAB EQUIPMENT

November 2020

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McPherson announced the availability of two new series of spectrometers with a wide range of features to facilitate teaching and experimentation in vacuum and ultraviolet physics. The workstations are ideal for spectroscopy experiments in the vacuum ultraviolet regime, potentially advancing quantum information science and engineering. Spectroscopy was central to the development of quantum mechanics, including blackbody radiation and Einstein's photoelectric effect.

There are two experimental kits available, diagnostic and analytical. The diagnostic system equips the spectrometer with a sensitive CCD detector. Use it to measure spectral emission of laser interaction, high harmonic generation, plasma formation, luminescence, fluorescence and so on. The analytical system comes with a tunable deep UV light source, rather than the CCD detector, and is ready to explore one of the earliest precursors of quantum physics, Einstein's photoelectric effect. The configuration is also good for measuring transmission, photoconductive response, and reflection.

Key features of these workstations include a versatile and easy to use spectrometer. It has, open concept high-vacuum sample chamber with built in optical breadboard, and easy to use vacuum pumping system. Systems may also have a deep UV light source and/or sensitive CCD detector. Students and experienced experimentalists will have more time to consider setup and interpret results when using these systems. In addition to optical characterization, perform basic physics experiments that explore the field of quantum behaviors useful for very practical technologies like quantum cryptography. More science means more engagement while also learning the fundamentals of laboratory setups. For more information, contact Erik Schoeffel, McPherson Inc. Email: erik.schoeffel@McPherson.com, P.O. Box 256-4512, 1-800-255-1050. SPECTROSCOPY.MARKETPLACE.COM

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For more information, contact Wasatch Photonics. Email: info@wasatchphotonics.com, P.O. Box 344-7785

Teledyne Princeton Instruments recently introduced their new TPR-785 Raman spectrometer, a fully integrated system that leverages leading-edge spectrograph and camera technologies to optimize performance in the near-infrared (NIR) region. The TPR-785 is an ultra-high-sensitivity spectrometer for NIR spectroscopic applications such as biology, medical research and life science where NIR excitation lasers (785 nm and 830 nm) are preferred for their low fluorescence and deeper penetration depth when measuring biological tissues.

This new system utilizes an 82 spectrograph with custom-designed lens optics to provide the highest light throughput and imaging quality in the NIR spectral range. The TPR-785 also allows users to tailor the instrument's performance for optimal spectral resolution (up to 5 cm^{-1}) or optimal spectral range (up to $80 - 3650 \text{ cm}^{-1}$). The system includes a 785 nm Raman probe, a universal fiber adaptor, a manual adjustable slit, and a high-power and temperature-stabilized 785 nm laser. For more information, contact [Teledyne Princeton Instruments](mailto:info@teledynepi.com). Email: info@teledynepi.com, P.O. Box 474-2226. SPECTROSCOPY.MARKETPLACE.COM

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November	October 27, 2022
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SAS eNews
November 2020

SAS New York/New Jersey Calendar of Events

The New York and New Jersey SAS section has planned out several exciting Zoom topics for the next several months. The link below has a copy of the tentative schedule of speakers who will be presenting to the SAS section. While we hope to be meeting you sooner than later, it is the officer's hope that members will be able to enjoy and engage these talks. If there are any questions, please do not hesitate to reach out to one of the related to our next meeting on 12 November 2020 follow the table [Click for more info](#).

Section on Advancing Diversity and Inclusion in Spectroscopy (ADIS) Members and Leaders

The Society for Applied Spectroscopy is forming a new special interest section to help Society and increase membership through attracting and retaining spectroscopists from underrepresented groups in STEM. The Executive Committee is financially supporting this committee to engage targeted projects, such as initiating a Summer Research Fellow graduate students. We envision that ADIS will work synergistically with the SAS News and a new section for early career spectroscopists. Consequently, we are looking for energetic, team oriented, committee members to help jump-start ADIS and participate also interested. If you are interested in joining ADIS, please contact Karl Booksh at kbooksh@sas.org.

Contributed by Karl Booksh, 2021 SAS President

Job Opportunity: SAS and Applied Spectroscopy are seeking role of Managing Editor for the journal

The Managing Editor is responsible for overseeing all phases of the production process of twelve issues annually in a timely manner, reporting directly to the Editor-in-Chief, as well as staying abreast of important developments in the field of applied spectroscopy. For more information, please see the [Applied Spectroscopy Managing Editor Job Description](#). [Click for more info](#).

Awards of Note for SciX 2020

The Career Award
Dr. Claudia Conti is a senior researcher at the Institute of Heritage Science (ISPC) of the Italian National Research Council (CNR) where she leads the Raman Spectroscopy Laboratory. Through her Ph.D. in Material Engineering (Milan Polytechnic, 2010), under the direction of Professor Giuseppe Zerbi, and her research in 1999-2008, she established expertise in the area of advanced applications of vibrational

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