Raman Update

by : The Raman Division

Issue: Spring 2004

Welcome to the Raman Update, produced by Jobin Yvon's Raman Team, to provide our customers, colleagues & friends with up-to-date information in the field of Raman Instrumentation and Application.

Don't forget to see us at:

Pittcon 2004, Chicago, USA and **Analytica 2004**, Munich, Germany

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Archeological Investigations: a Raman Tour of Pompei

By Pietro Baraldi, Università degli Studi di Modena e Reggio Emilia, and Massimo Placidi, Jobin Yvon S.r.l., Italy

Application

Introduction

Non destructive analyses by Raman spectroscopy provide information on materials, practices and alterations, information which is essential for art historians, conservators and restorers. Significant advances in Raman instrumentation and the development of portable systems allow more explicit investigations of art objects and enable in situ measurements to take place on archaeological sites.

Pompei

Presented here is one of the studies :
A vermiculatum mosaic from the Pompeii area has been studied *in situ* by dispersive Raman Spectroscopy.

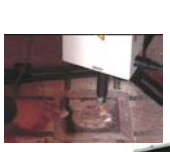


Figure 2: Detail of instrument set-up for in situ measurements.

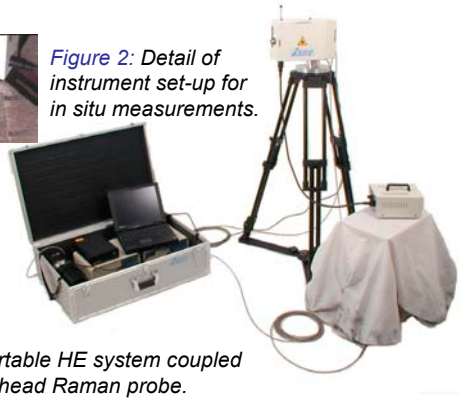


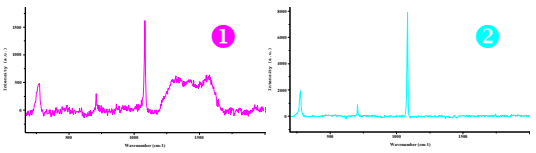
Figure 1: Portable HE system coupled to the Superhead Raman probe.

Description of the system :

A portable HE Raman system coupled to a fiber-optic Raman probe has been used to realise these *in situ* measurements. The HE, High Efficiency Raman Spectrometer is extremely stable and robust making it ideal for remote analysis. The compact Superhead probe, equipped with visualisation option, was connected to the HE spectrometer, enabling remote Raman analysis and visual interrogation of the sample to be easily achieved.

Raman characterisation of a vermiculatum mosaic:

Raman spectra have been recorded in order to characterise the composition of the different parts of the mosaic.



Several components have been identified from the Raman spectra :

1. Calcite, carbon and quartz
2. Calcite
3. Mainly gypsum and carbon
4. XSi_2O_6 with X=Ca, Fe, Al, Mg (eg. Giadeite, Diopside)

The different compositions of the mortar found at the site could reflect that the building of the vermiculatum and of the mosaic floor itself may originate from different historical periods.

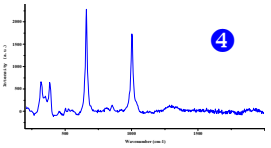


Figure 3: Dispersive Raman Spectra from the different locations.

Application

New Information on the Atherosclerotic Disease Process: *Investigations by Raman and FTIR*

By Fran Adar[a], Linda Jelicks[b], Coralie Naudin[a], Denis Rousseau[b], Syrun-ru Yeh[b]; [a] Jobin Yvon Inc, [b] Albert Einstein School of Medicine

*Raman and FTIR microprobe spectroscopy have been used to characterize the atherosclerotic process in **Apo E and wild type mice**. Atherosclerosis, a disease causing hardening of blood vessel walls, involves the deposition of lipid, cholesterol, calcium and other components on the inner lining of the vessels. Determination of the molecular composition of these deposits can be helpful in predicting the outcome and in selecting medical intervention.*

A knock-out mouse has been developed to be lacking in Apolipoprotein E which is involved in the transport of cholesterol and triglycerides. These animals develop lesions that are well characterized and similar to those found in humans. Raman and FTIR spectra are being investigated to provide missing molecular information. We also found that Raman spectra can be used to quantitate the degree of unsaturation of lipids incorporated into tissue.

Compositional Mapping - Both Raman and FTIR spectra are capable of distinguishing protein from lipid with microscopic resolution. The first figure shows the FTIR spectra of a protein rich (top spectrum) and lipid regions. These spectra were recorded in contact mode using the All Reflecting objective (ATR). Figure 2 shows a black and white image of a region of the lumen (inside) of an aorta, side-to-side with a Raman map created by the modeling capabilities of the LabRAM software.

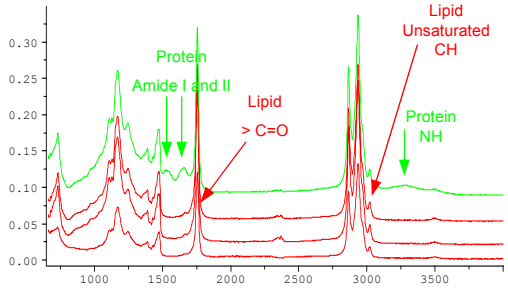


Figure 1: ATR FTIR spectra recorded from a Wild type mouse fed a High fat Diet.

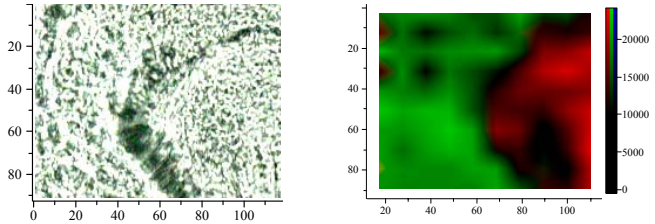


Figure 2: Micrograph of lumen side of aorta showing fatty and proteinaceous regions with the corresponding Raman map, color-coded with green as protein and red as lipid.

Newly Discovered Chemical Species – Two new discoveries were made in our studies. In one case we examined the aorta of a "very old" normal mouse (15 months) and found **calcification** regions containing **calcite**, a common mineral form of calcium carbonate ($CaCO_3$). The presence of calcite as the mineral form of calcification suggests that the carbonic anhydrase enzyme (which is normally present at high quantities) is either less abundant in aged animals, or less active.

In the second case, the Raman microscope spectra from isolated globules of fatty material in the knock out mouse was found to be composed of **free fatty acid**. The free fatty acid can be distinguished from triglycerides because it is lacking in the >C=O band. The conclusion is that the deposited fats in this region are non-esterified which means that there has been metabolic modification of the dietary fats. In addition, careful inspection of the globule spectrum also indicates the presence of many bands that are suggestive of cholesterol.

For further details on this study featured at SPIE in January 2004, please refer to the application note on our website.

The System

LabRAM-IR

The LabRAM-IR is a combination FTIR/Raman System. Samespot™ technology enables simultaneous examination of the sample by both technique. The **FTIR Module** is designed as a compact unit which easily and efficiently couples with any LabRAM-type Raman microscope. The spectrometer optics and electronics are all incorporated into the base unit which minimizes the instrument footprint.

Element Analysis with X-ray Fluorescence: *the new Horiba XGT-5000*

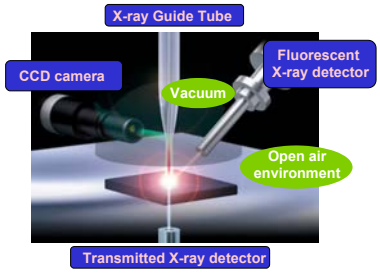
By Dr Ingo Reese, Jobin Yvon GmbH

New Technology

Combination of microscopic, transmission and elemental analysis with highest spatial resolution makes this instrument to a powerful tool for a wide range of applications

The XGT-5000 allows elemental analysis from sodium to uranium, without any sample preparation and without vacuum. Full qualitative and quantitative results are achieved by simply placing the sample in the sample chamber and carrying out a few clicks.

The X-ray beam is focussed through a glass mono-capillary with a unique beam diameter of only 10 microns. The parallel shape of the beam guarantees high resolution mapping and transmission images, even from samples with irregular surfaces. In comparison with polycapillary instruments, the resolution is 10x better for low energy X-ray fluorescence lines. The element mapping can be performed on very large to very small areas.



The transmission capability creates a view inside the sample; this image can be used to perform automated multi-point measurements.

The short working distance, only 1mm between sample and X-ray window, minimises the absorption of fluorescent X-ray emission by air, hence no vacuum is required. This is very important to analyse light elements (e.g. Na, Mg, Al, Si, P, S) under ambient conditions for example in liquids, powders, water containing or biological samples.

Typical applications for the system include defect/failure analysis in electronics, contamination in pharmaceuticals, art/forensics, mineralogy, steel industry, general quality control, ...

*The **XGT-5000** can be seen and tested in our application laboratories, as well as at **Pittcon 2004** and **Analytica 2004**.*

Release Date:
May 2004

New Raman Software: *NextGen*

Software

By Dr Serguei Charonov, Jobin Yvon S.A.S.

The new NextGen Raman software package has continued to develop the highly successful LabSPEC software still further. The open architecture software structure with a central KERNEL design, provides a flexible format and enables specially designed modules or operations to be incorporated with greater ease and efficiency. Widget technology enables creating a combined Graphic User Interface (GUI) exposed by different modules NextGen framework supports the possibility to use advanced technologies (COM+, Client/Server).

The NextGen Raman software family includes the following members:

- General data acquisition and data analysis software: controls all Jobin Yvon Raman instruments, enables different data acquisition modes (eg. single spectrum, multidimensional data set, video images etc.) and provides usual spectral analysis routines. (Figure: 2)
- Control software: dedicated for industrial application and enables automatic data recording with specific analysis procedures
- Raman server: provides access to Jobin Yvon Raman instruments and data analysis functions to 3rd part container.

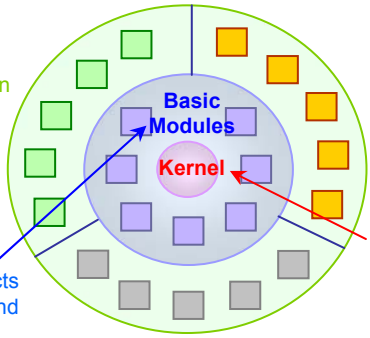


Figure 1: NextGen Structure

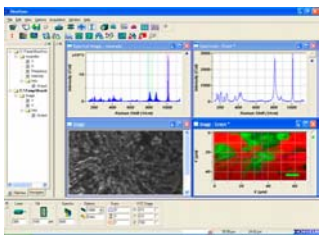


Figure 2: Software Outlook

*Check out the **NextGen** Raman software package at **Analytica 2004**.*

The Head office of Jobin Yvon's Raman Division is located in Villeneuve d'Ascq (Lille), in the north of France. This location was originally chosen by Prof. Delhaye and Dr. Da Silva due to close ties between the R&D team and the scientific community at the LASIR (University of Lille), originators and experts in the design and application of optical instrumentation for Raman spectroscopy.

The large facility incorporates the:

- R&D department
- Application Laboratory
- Production department
- Quality control and service department
- Sales and sales support department

Further more, the Raman division has offices all around the world to support all customers and also additional application laboratories in the USA and Japan.

The Jobin Yvon Raman Division is proud to offer the largest range of Raman products: from Triple to Double to Single (T64000, U1000, LabRAM product family, InduRAM, HE, AXIAL).

This wide selection of systems allows the customer to choose the best configuration to support the application. The Jobin Yvon Raman systems are used for :

- Research
- Analytical applications
- Process control and QC/QA applications

Forthcoming Exhibitions:

8-11th March 2004 **Pittcon 2004**, Chicago, USA
17-19th March **Nano Tech,** Tokyo, Japan
17-19th March **Semicon China,** Shanghai, China
22-26th March **APS March Meeting**, Montreal, Canada
28th March – 2nd April **ACS**, Anaheim, USA
30th March – 2nd April **ICSO 2004**, Toulouse, France
12-16th April **MRS Spring**, San Francisco, USA
20-22nd April **Semicon Europe**, Munich, Germany
27-29th April **Photonics Europe**, Strasbourg, France
11-14th May **Analytica 2004**, Munich, Germany
25-27th May **MRS**, Strasbourg, France
6-11th June **GeoRaman**, Honolulu, Hawaii
17-19th June **Stratum Corneum IV**, Paris, France
23-24th June **SURFEX**, Manchester, UK
6-8th July **Microscience**, London, UK
1-6th August **SPIE**, Denver, USA
8-13th August **ICORS 2004**, Gold Coast, Australia

For further information on any of the articles within this newsletter, or should any of your colleagues wish to be part of our mailing list, or should you have any queries or comments, please contact any of the following addresses :

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where you can find details on all our systems, accessories, along with complementary information including our application notes.