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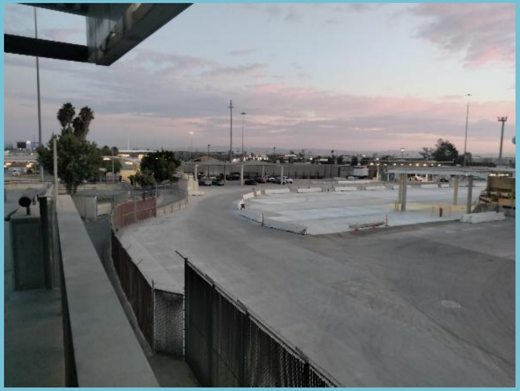
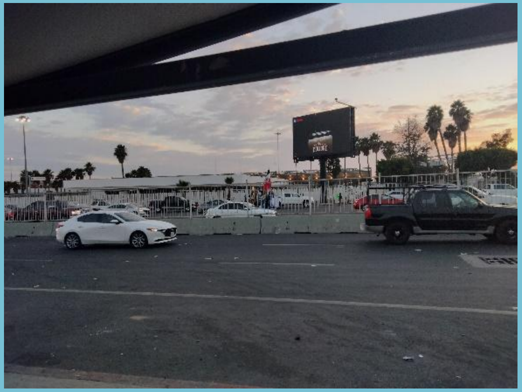
Development of spectroscopic detection and neutralization strategies for biological threats crossing our border

Michael Pravica, Ph.D.
Professor of Physics
University of Nevada Las Vegas


CBTS Presentation
October 27, 2022

Cross-Border Threat Screening and Supply Chain Defense

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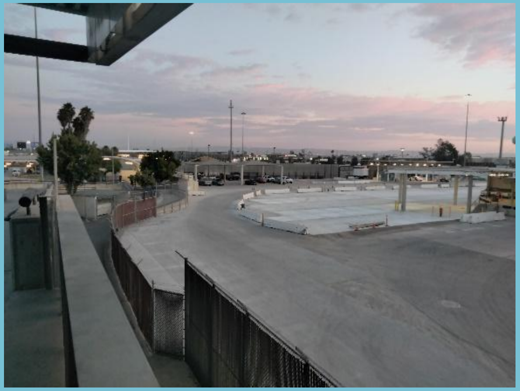

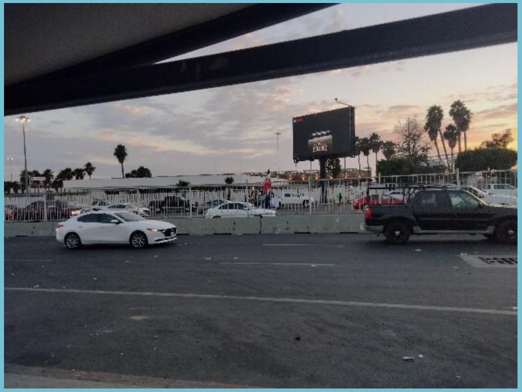

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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

Progress Report

1. We are developing a hybrid Raman and UV/Vis spectrometer for rapid detection of some threats.
2. We have some ideas to share.
3. We are also developing ideas pertaining to eradication of immediate threats.

We examined 4 types of threats:

a. Viral (Tobacco Mosaic Virus/TMV)
b. Bacterial (K12 Ecoli)
c. Mold (Yeast)
d. Chemical/poison (ibuprofen, acetaminophen, children's aspirin,
e. pure aspirin, nicotine)

There are largely two types of detection strategies:

A. Detection via chemical alteration/reaction (e.g. PCR); i.e ACTIVE
B. Detection via minimal or no chemical alteration (e.g. Raman/IR); i.e. PASSIVE

OPEN

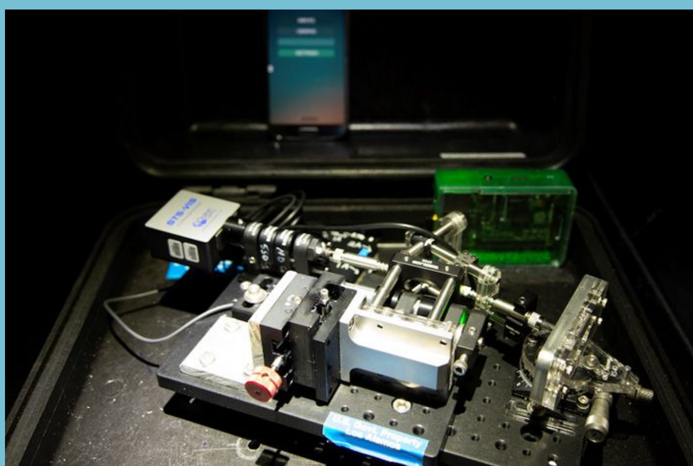
Microsystems & Nanoengineering (2018) **4**, 17083; doi:10.1038/micronano.2017.83
www.nature.com/micronano

ARTICLE

Field-deployable rapid multiple biosensing system for detection of chemical and biological warfare agents

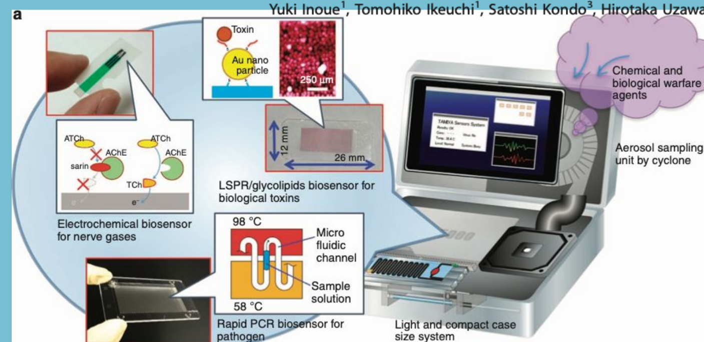
Masato Saito[1,2], Natsuko Uchida[3], Shunsuke Furutani[2,4], Mizuho Murahashi[1], Wilfred Espulgar[1], Naoki Nagatani[5], Hidenori Nagai[2,4], Yuki Inoue[1], Tomohiko Ikeuchi[1], Satoshi Kondo[3], Hirotaka Uzawa[3], Yasuo Seto[6] and Eiichi Tamiya[1]

ACTIVE examples:



https://www.lanl.gov/discover/news-release-archive/
2021/April/0422-pegasus-biosensor.php

a



b

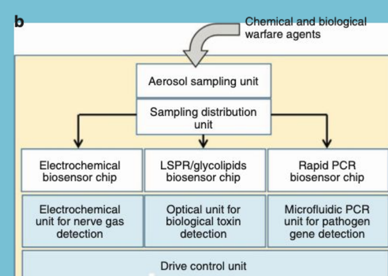


Figure 6 Prototype of the integrated automated portable device. All parts of the device are assembled in a compact 300 mm × 300 mm × 300 mm and 12.8 kg container. The device runs with a 24-V battery power source and is connected to a tablet screen.

Figure 1 (**a**) Scheme of our concept of the on-site device system for evaluating the presence of chemical and biological warfare agents rapidly and with high sensitivity. This system works autonomously from air sampling to detection by integrating the air-sampling unit based on cyclone technology and detection system units using biosensor chip device technologies, such as electrochemical measurement, LSPR, and on-chip PCR. In addition, the system is lightweight and compact in size for portability. (**b**) System composition. Initially, chemical and biological warfare agents in the air are harvested into the aerosol-sampling unit. The collected sample solution is distributed to separated biosensor chips and then measured. All units are operated by the control unit. Note that the parts indicated in the white-colored boxes are considered disposable. ATCh, acetylthiocholine; AChE, acetylcholinesterase; LSPR, localized surface plasmon resonance; TCh, thiocoline.

Factors to consider/boundary conditions:

1. Does the interrogation method damage the sample?
2. Is it dangerous to the operator?
3. How much training is required for the operator?
4. How long does it take to perform?
5. Expense
6. Reliability/ruggedness of equipment
7. Possibility for remote detection?
8. Reagents/chemicals/repeated measurements/supplies
9. Measurements in extreme conditions (e.g. high temperature)

We decided to focus on PASSIVE/spectroscopic methods for rapid testing.

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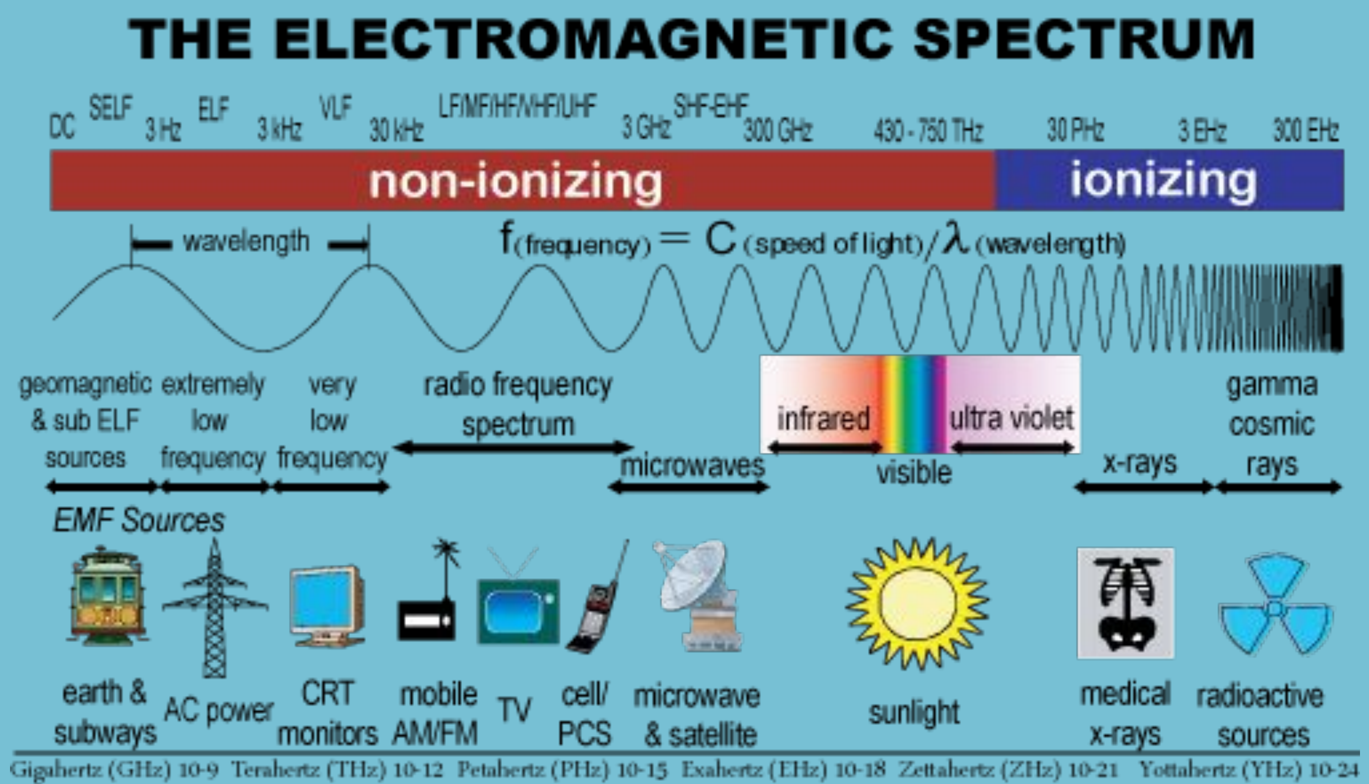

Energy (eVs)→

https://socratic.org/questions/what-is-the-electromagnetic-spectrum-used-for

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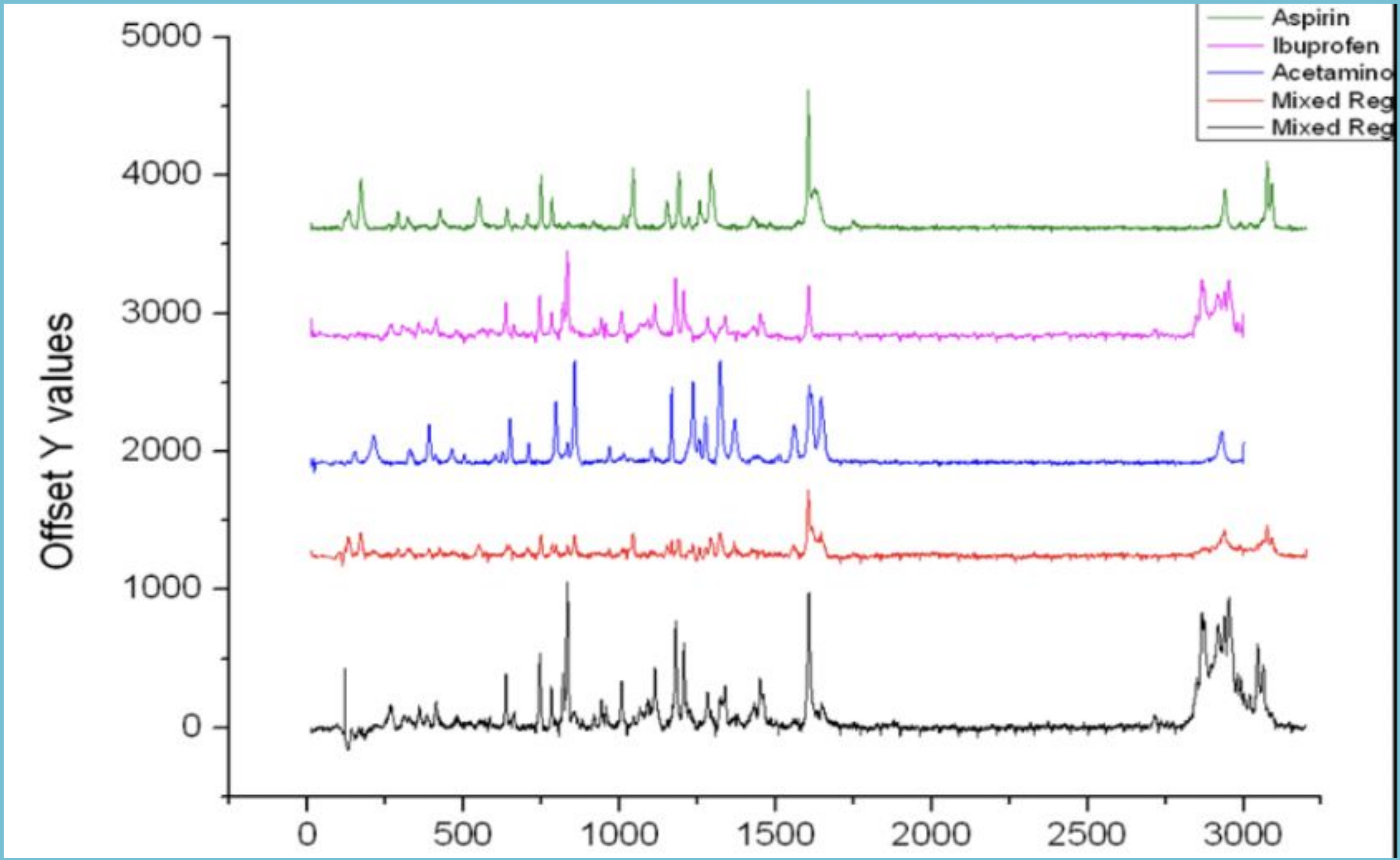
CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

Spectroscopic methods we tried:

1. Raman spectroscopy
2. UV/Visible absorption spectroscopy
3. NMR
4. Cyclic voltammetry
5. Fluorescence spectroscopy

Raman Spectra



Raman spectra of aspirin (top), acetaminophen (2nd from top), and ibuprofen (3rd from top) powders. The lower 2 traces are Raman spectra of various mixtures of these 3 constituents.

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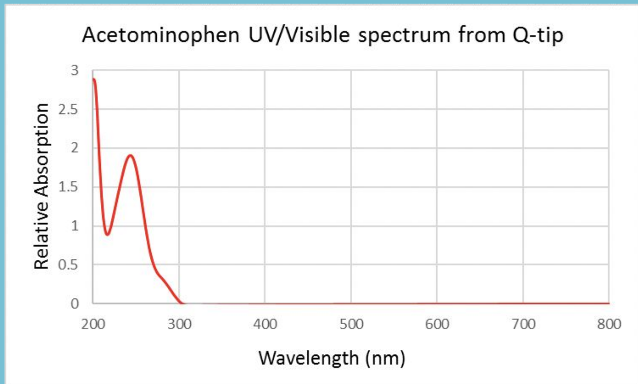
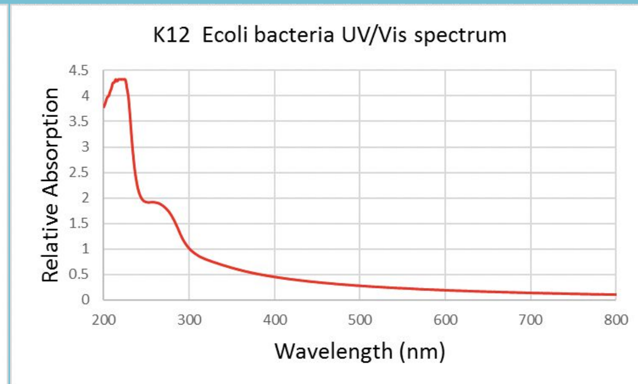
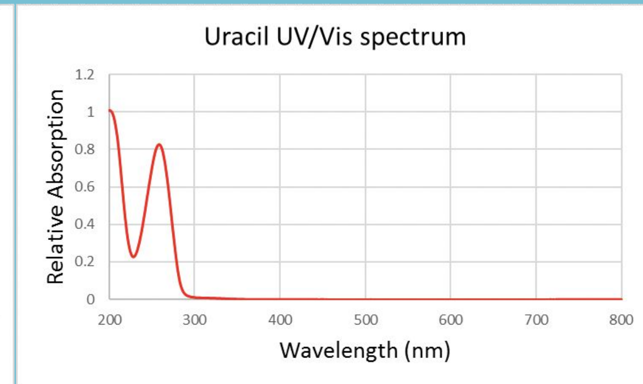
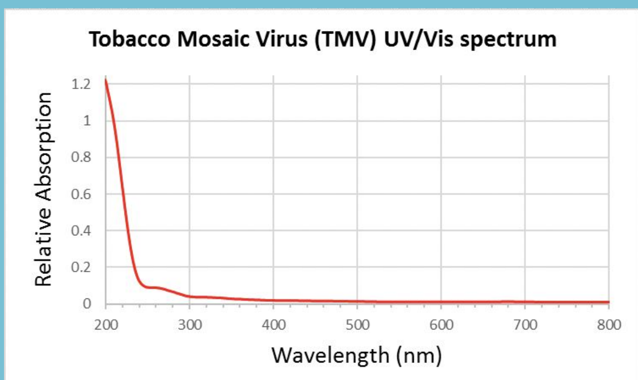
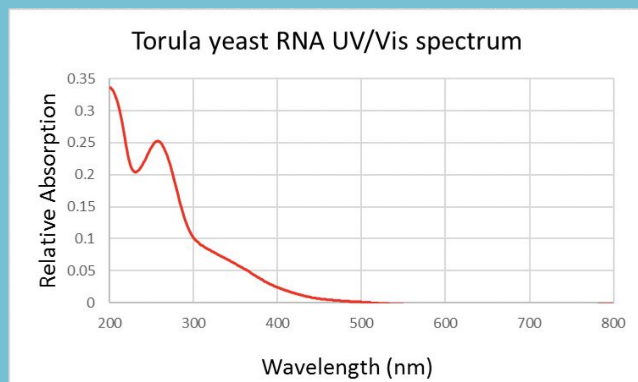
UV/Vis absorption spectra

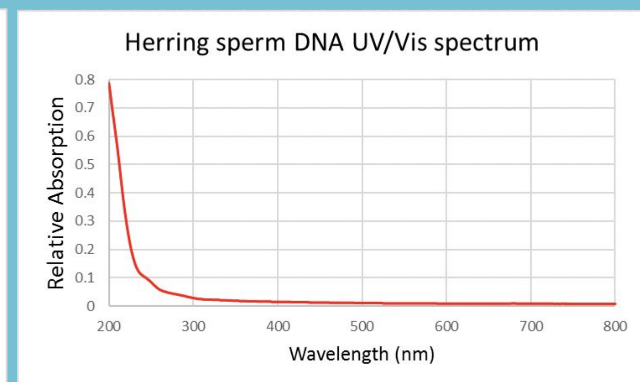












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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

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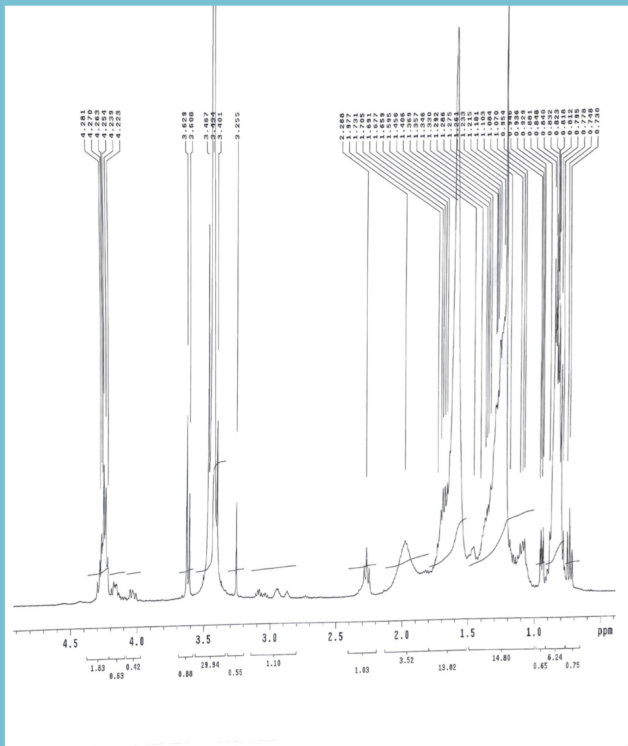
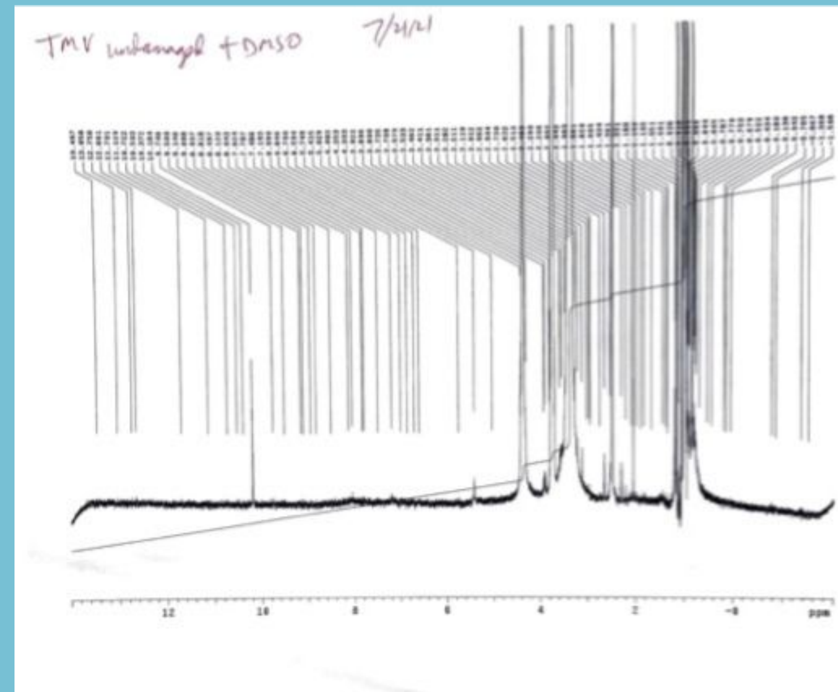
NMR Spectra





Proton NMR spectra of yeast (left) and TMV (right).

CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

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One suggested approach:

Raman→UV/Vis→NMR→ACTIVE

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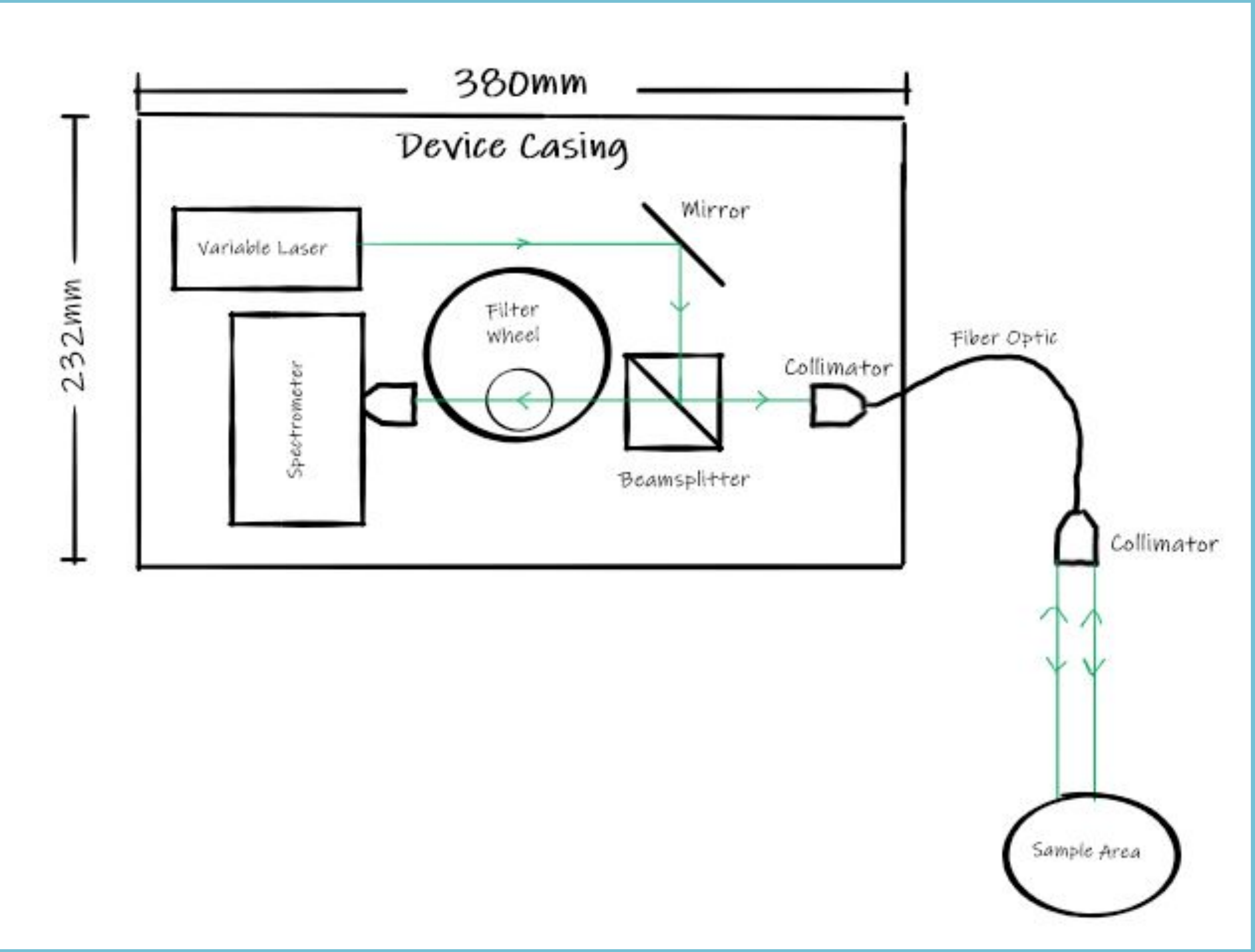
Proposed setup (sketch):



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Portable Raman spectrometer (example)

Technical Information

smiths detection
bringing technology to life

ACE-ID™

NON-CONTACT EXPLOSIVES & NARCOTICS IDENTIFIER
WITH ORS TECHNOLOGY

Feature Highlights

- **Rapidly identifies solids, liquids, gels and powders**
- **Proprietary mixture analysis software enables identification of up to two components within sample**
- **Integration software kit for remote operation and report generation**
- **Compact, robust and lightweight**
- **Orbital Raster Scan (ORS) technology diffuses laser energy to reduce the risk of heating samples and igniting energetic materials**
- **MIL-STD-810G compliant for rugged use in harsh conditions and operation in extreme temperatures (-20C to +50C)**

www.smithsdetection.com

ACE-ID is a next-generation, handheld Raman identifier for explosives and narcotics that analyzes solids, powders, liquids, and water based solutions as well as performs mixture analysis.

Utilizing Raman spectroscopy, ACE-ID enables non-contact analysis, yielding rapid results in seconds. Materials can be identified through translucent and semi-translucent containers such as plastic and glass. In addition, analysis is also supported by a software kit for remote operation.

ACE-ID is MIL-STD-810G compliant for rugged use in harsh conditions and operation in extreme temperatures (-20C to +50C). It is lightweight and can be operated with just one hand.

An intuitive software interface guides users through the entire identification process making it easy-to-use with minimal training.

ACE-ID utilizes an advanced Orbital Raster Scan (ORS) optical platform to diffuse laser energy, reducing the risk of heating samples and igniting energetic materials. It also provides operation using an off-the-shelf lithium battery.

ACE-ID is backed by ReachBackID™, a first-rate 24/7/365 service and support program to ensure optimum product performance.

ACE-ID is a product from Smiths Detection, a leading worldwide provider of government regulated technology products and advanced services that aid in the detection and identification of chemical, biological, radiological, nuclear and explosive (CBRNE) material and other dangerous or illegal substances.

Technical Data **ACE-ID**

General Specifications	
Technology	Raman
Size	12.7 x 8.9 x 5.6 cm (5 x 3.5 x 2.2 in)
Weight	0.45kg (1lb)
Sampling	Point and shoot
Library	Approximately 500 substances consisting of explosives, precursors, narcotics, and toxic chemicals
User library	Ability to add user defined samples via laptop
Start-up time	Less than 20 sec at 20°C (68°F)
Detection time	Less than 20 sec at 20°C (68°F)
Power	One lithium battery (CR123A) or USB power source
Display	Touchscreen display (compatible with level A PPE gloves)
Connectivity	Micro USB
Operating temperature	-20°C to +50°C (-4°F to 122°F)
Storage temperature range	-40°C to +70°C (-40°F to 158°F)
Operating humidity	>95%
Color	Olive drab

Fast and easy analysis of multi-layered liquids, no sampling required.

Ergonomically designed for one handed operation with touchscreen interface.

Orbital Raster Scan (ORS) technology diffuses laser energy, reducing the risk of heating samples and igniting energetic materials.

CAUTION
INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
55 mW max at 785 nm
Complies with FDA performance standards except for deviations pursuant to Laser Notice No. 50: June 24, 2007
EN/IEC 60825-1 Ed. 2.0 (2007)

For product information, sales or service, please go to www.smithsdetection.com/locations

smiths detection

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Portable UV/Visible spectrometer (example)

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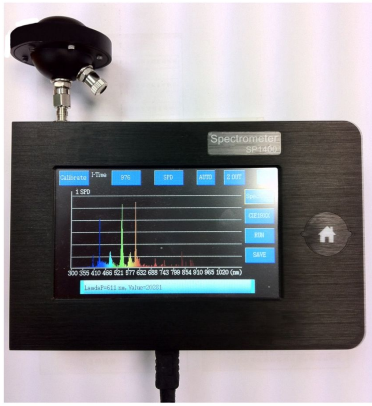
ABOUT US +1-800-253-4107

Products / Portable Spectrometer UV-VIS with LCD screen



Portable Spectrometer UV-VIS with LCD screen

US $ 3,000.00

Slit Width

10 (um)

Spectral Range (nm)

250~800nm

1

ADD TO CART

ADD TO COMPARE ADD TO WISHLIST

- USB2.0 or can be used without computer
- Robust Aluminum Housing
- SD card slot
- LCD screen 4.3 inches
- Replaced by SRI2000-UV

Description

ABOUT US +1-800-253-4107

This completely independent and portable spectrometer comes with a full LCD screen and built in analysis software making it possible to make measurements at any location. It also has batteries, no local power supply is required.

Data from either measurements or analysis can then be loaded onto flash memory or plugged straight into your computer for further evaluation at a later stage. Applications for this novel type of spectrometer include:

- Spectroscopy
- Absorption measurements
- Reflectance measurements
- Light source testing (e.g. LEDs)
- Detection of saccharic acids in food
- Taste analyzers
- Fluorescence measurement
- Industrial color measurement
- Tooth decay analysis
- Semiconductor inspection
- Chromatography
- DNA analysis

Additional Features

- mini-USB cable provided
- 4 AA batteries
- Compatible with Window XP, Vista, Windows 7
- SMA male fiber connector
- Including: USB cable, Software and DLL
- I/O external

Items	Specifications	Items	Specifications
Spectral Resolution	1.3 ~ 5.0 nm FWHM (varies by configuration)		
Wavelength Range	300-1000nm, 250-800nm, 380-760nm,700-1100nm, see table		
LCD Size	4.3 inches	Size	148(W) x 98.5(D) x 31.4(H) mm
A/D	16bits		
Interface	USB 2.0 or SD card		
Power supply	Battery or USB powered		

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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

Portable NMR/benchtop spectrometer (example)

Case Study

Rapid screening of street drugs by benchtop NMR

The spread of illicit drugs has become a global problem, not only causing direct harm to people's physical and mental health, but also seriously affecting social and economic development. In addition to traditional drugs, many new psychoactive substances (NPS) have appeared in recent years, and they are becoming increasingly popular. New psychoactive substances are also known as "designer drugs" or "laboratory drugs". To avoid prosecution, criminals artificially design and modify the chemical structure of controlled drugs to obtain new types with effects similar to or even stronger than those of the controlled drugs. Due to the "new structure" of these substances, some traditional detection methods have become invalid, presenting great challenges to the drug prevention and control work of the whole society.

Fast drug screening without expert operators

Nuclear Magnetic Resonance (NMR) technology can provide information on the connection of chemical molecular frameworks. It is the most direct tool for compound structure identification and can be used as an effective means to detect and identify new psychoactive substances. However, because traditional high-field superconducting NMR spectrometers have special requirements for operation and location, and because of the high cost of instrument use and maintenance, the application of NMR technology in rapid street drug screening is limited. In response to the above problems, Oxford Instruments has provided a new benchtop NMR solution for rapid drug identification. Oxford Instruments' X-Pulse benchtop NMR spectrometer uses rare earth permanent magnets, does not require liquid nitrogen, liquid helium or other refrigerants, is simple to operate and easy to maintain, and can quickly collect NMR spectra of suspicious drug samples.

Sample Match Criteria	Quantity	Percentage
Total number of samples analysed	**432**	
Unable to verify (GC-MS does not produce peaks)	13	3.0%
No API or admixtures	3	0.7%
Cannot match	4	0.9%
Correct match (single component sample)	374	86.6%
Correct match (two-component sample)	13	3.0%
Partial matching (two-component or multi-component samples)	25	5.8%
Verification of samples containing API or admixtures	**416**	
Exact match	387	93.0%
Exact + partial match	412	99.0%

Table 1. Analysis results of a batch of suspicious samples

A batch of suspicious samples seized by public security agencies was analysed by X-Pulse and gas chromatography-mass spectrometry (GC-MS) at the same time. The results are shown in Table 1. The total number of samples analysed was 432, of which 13 (3.0%) could not be verified by NMR due to there being no GC-MS peaks, and 3 (0.7%) contained no active ingredients (API) or admixtures. Among the remaining 416 samples that were confirmed to contain API or admixtures, 387 (93.0%) of the NMR and GC-MS test results were matched exactly. On this basis, if the partially matched samples are added, the total number reached 412 (99.0%). Of equal importance, no false positives were found. This data demonstrates that X-Pulse can detect and identify street drugs with high accuracy and reliability.

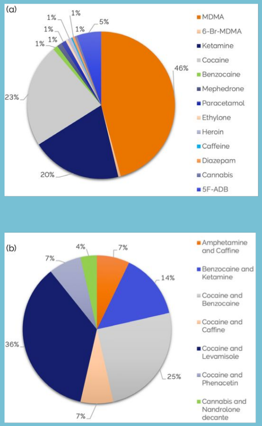

Figure 2. Types and quantities of street drugs detected by X-Pulse
(a) One-component compound; (b) Two-component mixture [1]

Identifying street drugs - data for judicial enforcement

Through comparison and matching with the X-Pulse drug database, it was found that more than 400 questionable samples contained a variety of different drugs. Among street drugs consisting of single-component compounds, the most often detected were ecstasy (MDMA), cocaine and ketamine; in the two-component mixture samples, cocaine/levamisole, cocaine/benzocaine, and other admixtures were mainly found (Figure 2). The results can provide valuable references for public security judicial identification agencies to understand the types and prevalence of local drugs, and to formulate corresponding control strategies and action plans.

References:

[1] Antonides LH et al., Rapid Identification of Novel Psychoactive and Other Controlled Substances Using Low-Field 1H NMR Spectroscopy, ACS Omega. 2019, 4: 7103-7112

[2] Mewis R et al., Quantification of MDMA in seized tablets using benchtop 1H NMR spectroscopy in the absence of internal standards, Forensic Chemistry, 2020, 20: 100263

Visit **nmr.oxinst.com**

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Visit to the San Ysidro and Otay Mesa DHS Border Facilities

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Cross-Border Threat Screening and Supply Chain Defense


RICIO 5-6-21


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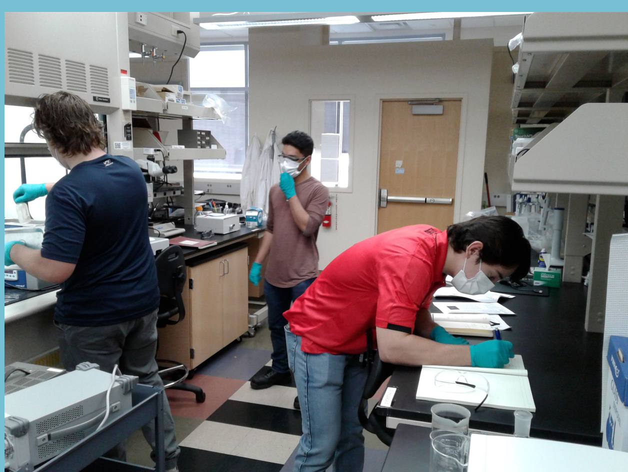
Merime Njegomir



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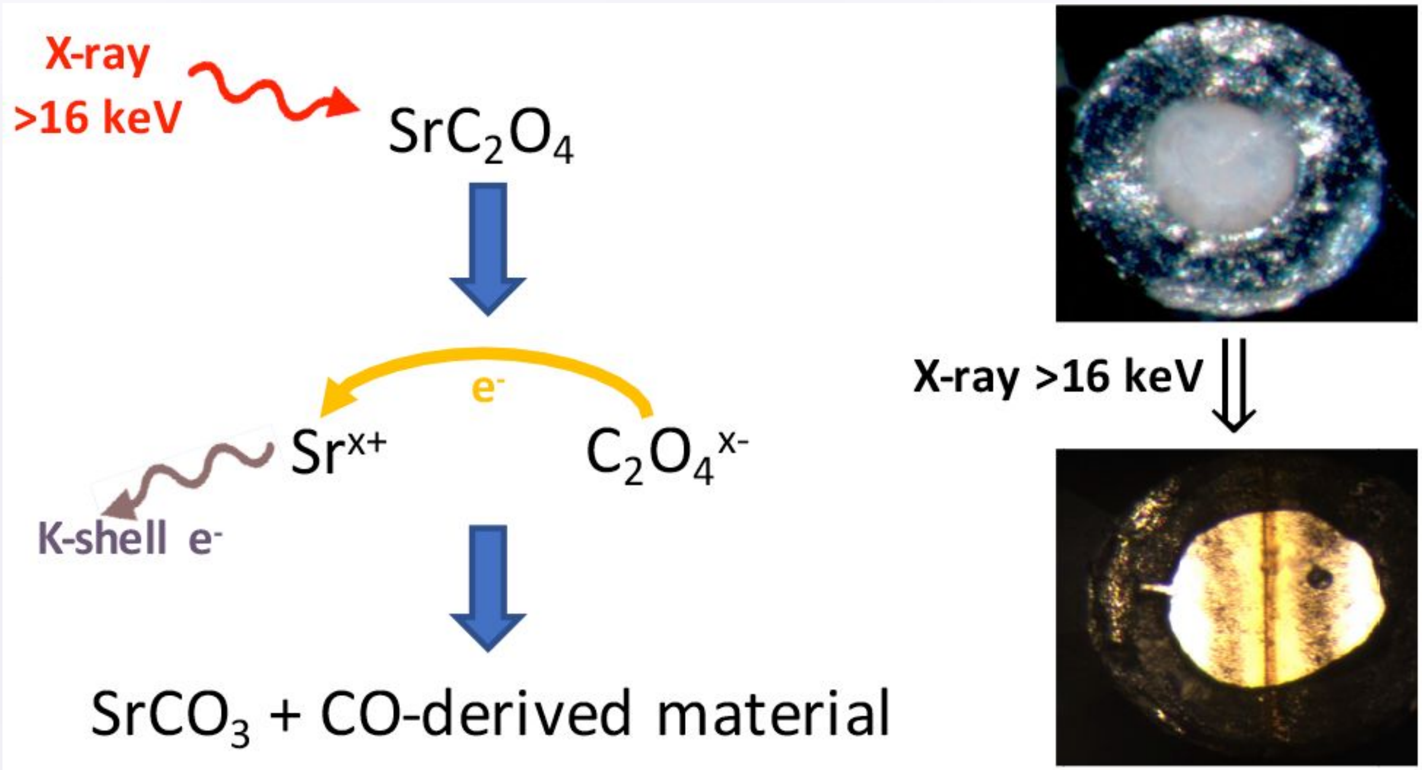
Cross-Border Threat Screening and Supply Chain Defense


UNLV

Controlled/selected decomposition with monochromatic hard x-rays

Decomposition of materials using tuned hard x-rays.



THE JOURNAL OF PHYSICAL CHEMISTRY A
Article
pubs.acs.org/JPCA

Measurement of the Energy and High-Pressure Dependence of X-ray-Induced Decomposition of Crystalline Strontium Oxalate

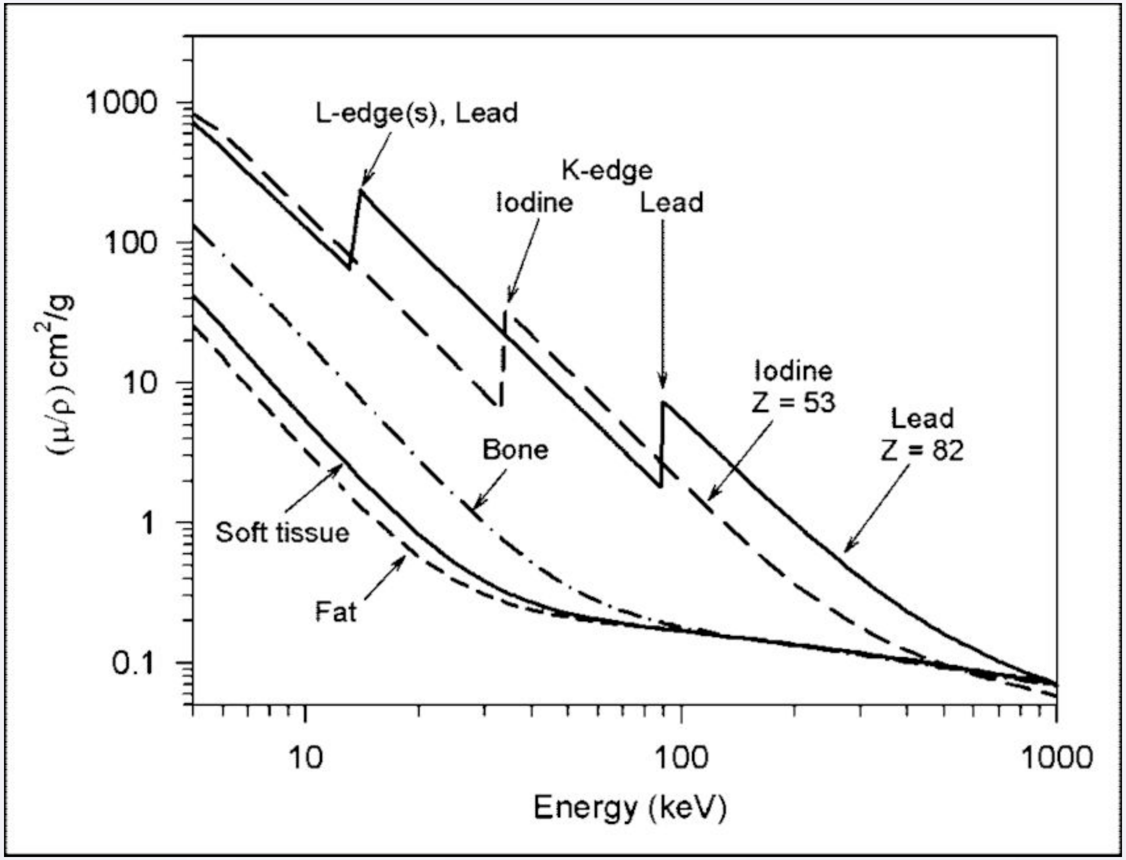
David Goldberger,[†] Egor Evlyukhin,[†] Petrika Cifligu,[†] Yonggang Wang,[‡] and Michael Pravica*[,†]

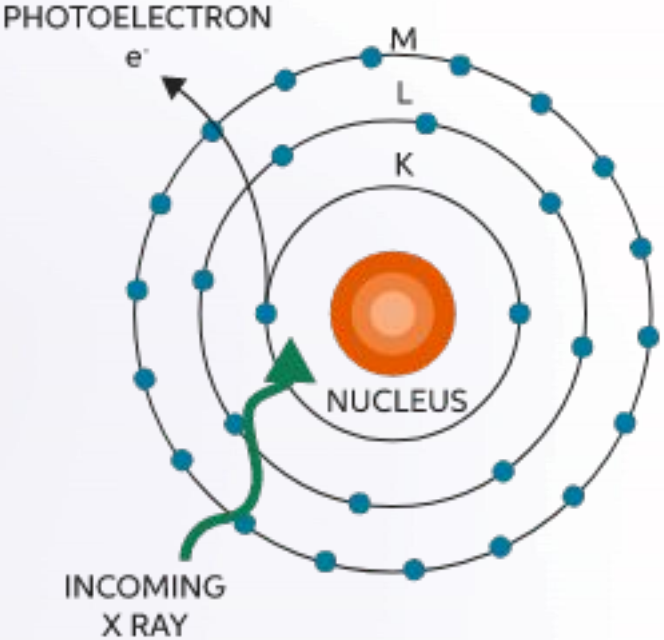
[†]High-Pressure Science and Engineering Center (HiPSEC) and Department of Physics, University of Nevada Las Vegas (UNLV), Las Vegas, Nevada 89154-4002, United States

[‡]HPCAT, Geophysical Laboratory, Carnegie Institution of Washington, 9700 South Cass Avenue, Argonne, Illinois 60437, United States

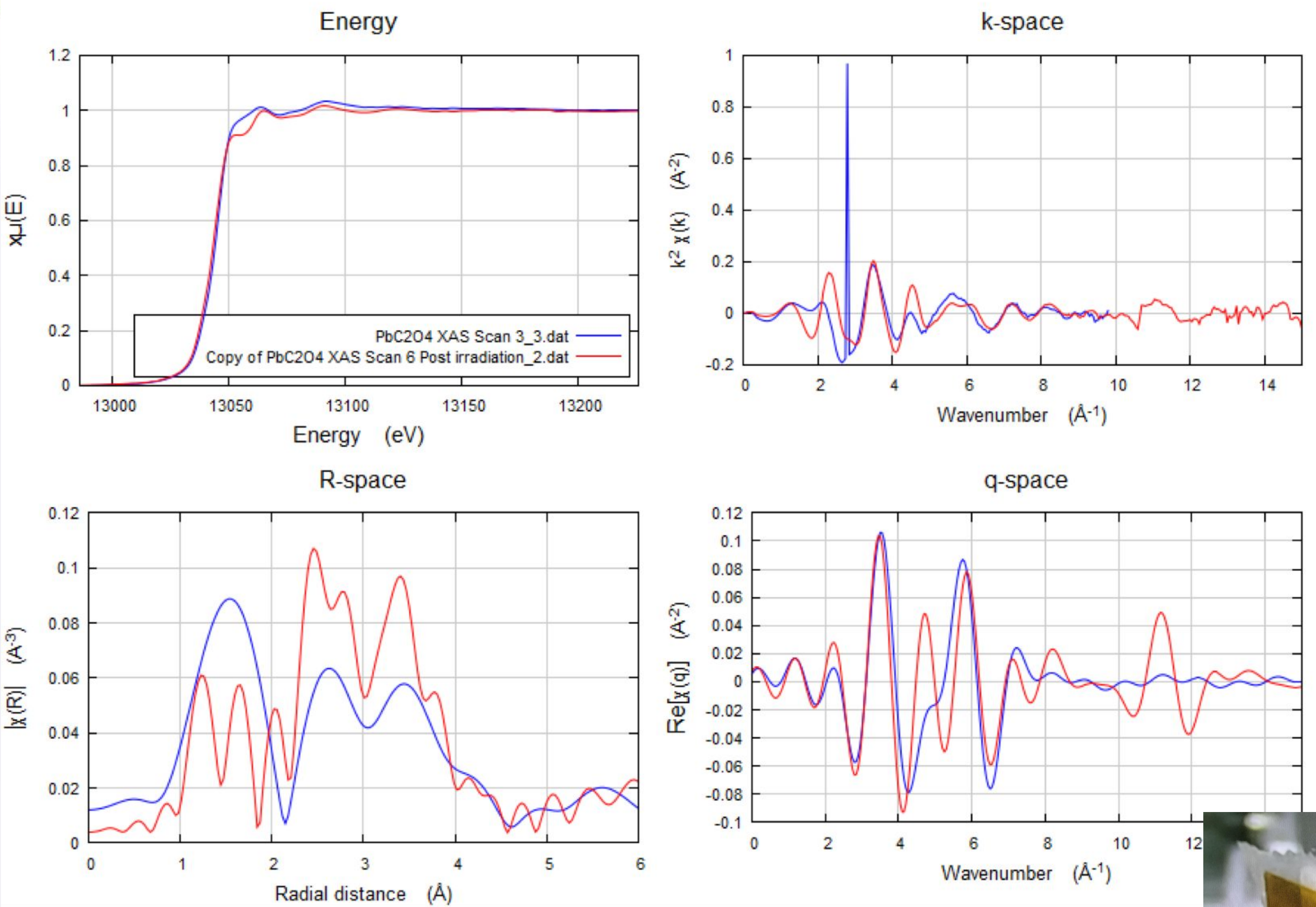
ICIP Talk
July 11, 2022

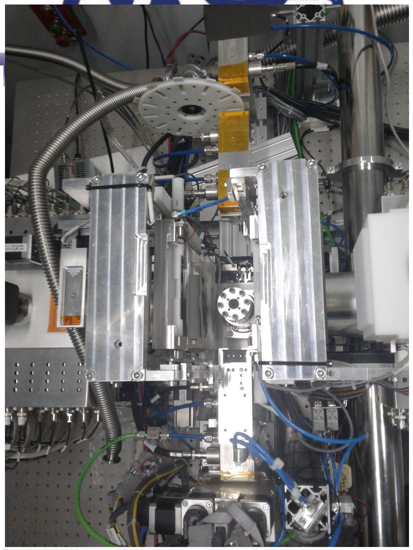
K-edge and L-edge absorption of x-rays

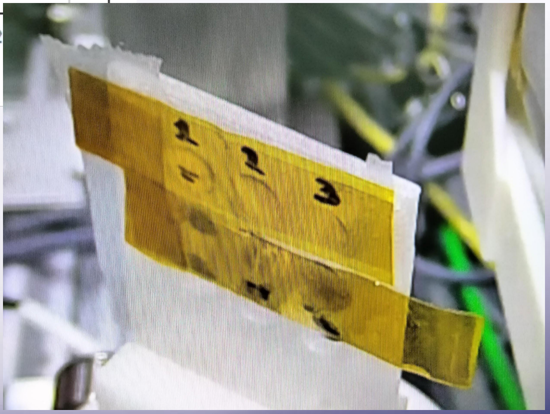




Evidence for L-edge induced chemistry







ICIP Talk
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Observation of molecular decomposition “resonances” in the hard x-ray regime.

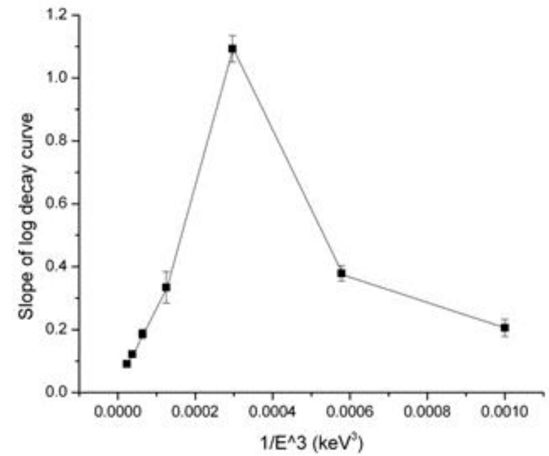
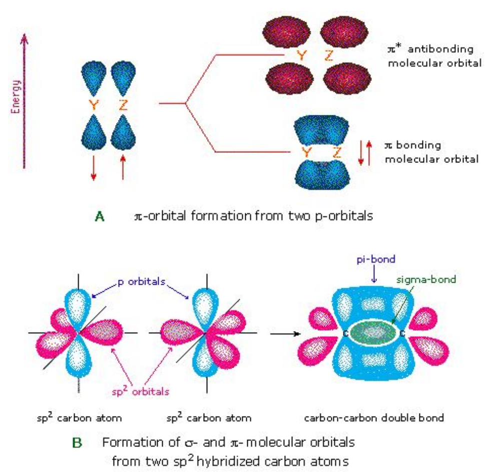
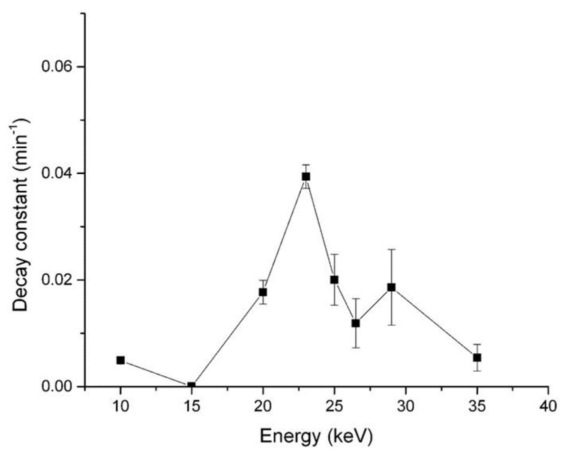
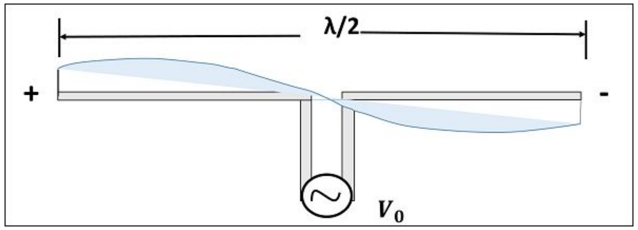


Fig 1: (Left): Schematic of x-ray irradiation of strontium oxalate just above the K-edge of Sr[6]. (Middle): photos of x-ray induced reaction of SrC_2O_4 (Right): X-ray induced decay of $KClO_3$ into KCl and O_2 as a function of x-ray energy.

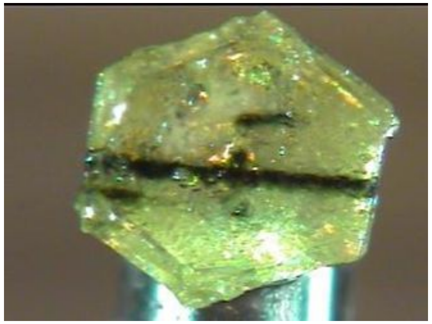


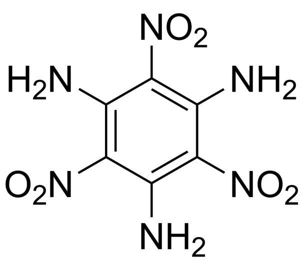




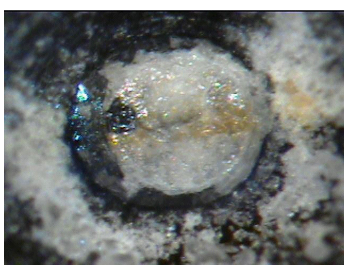
25 keV ~ 0.5 Å

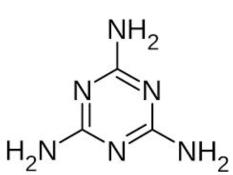
Nucleic acids and their incorporation into DNA/RNA



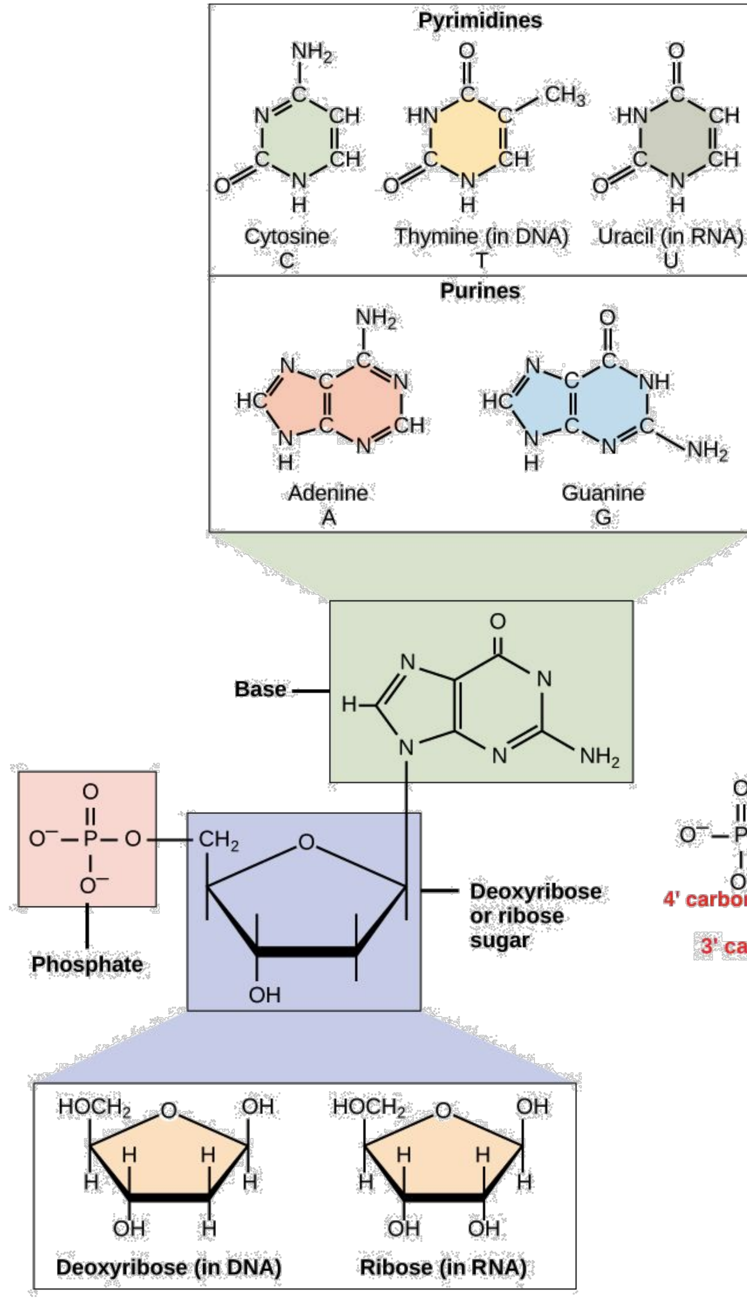


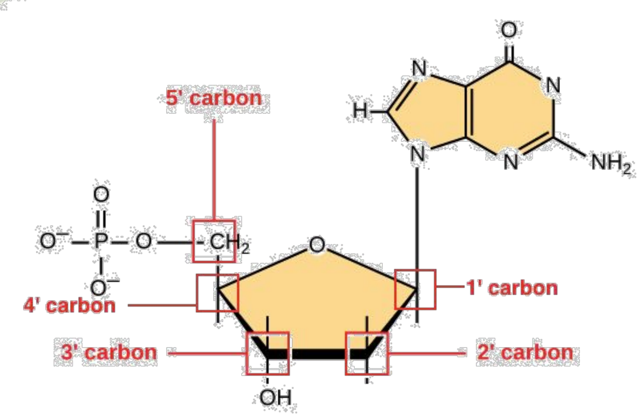
TATB



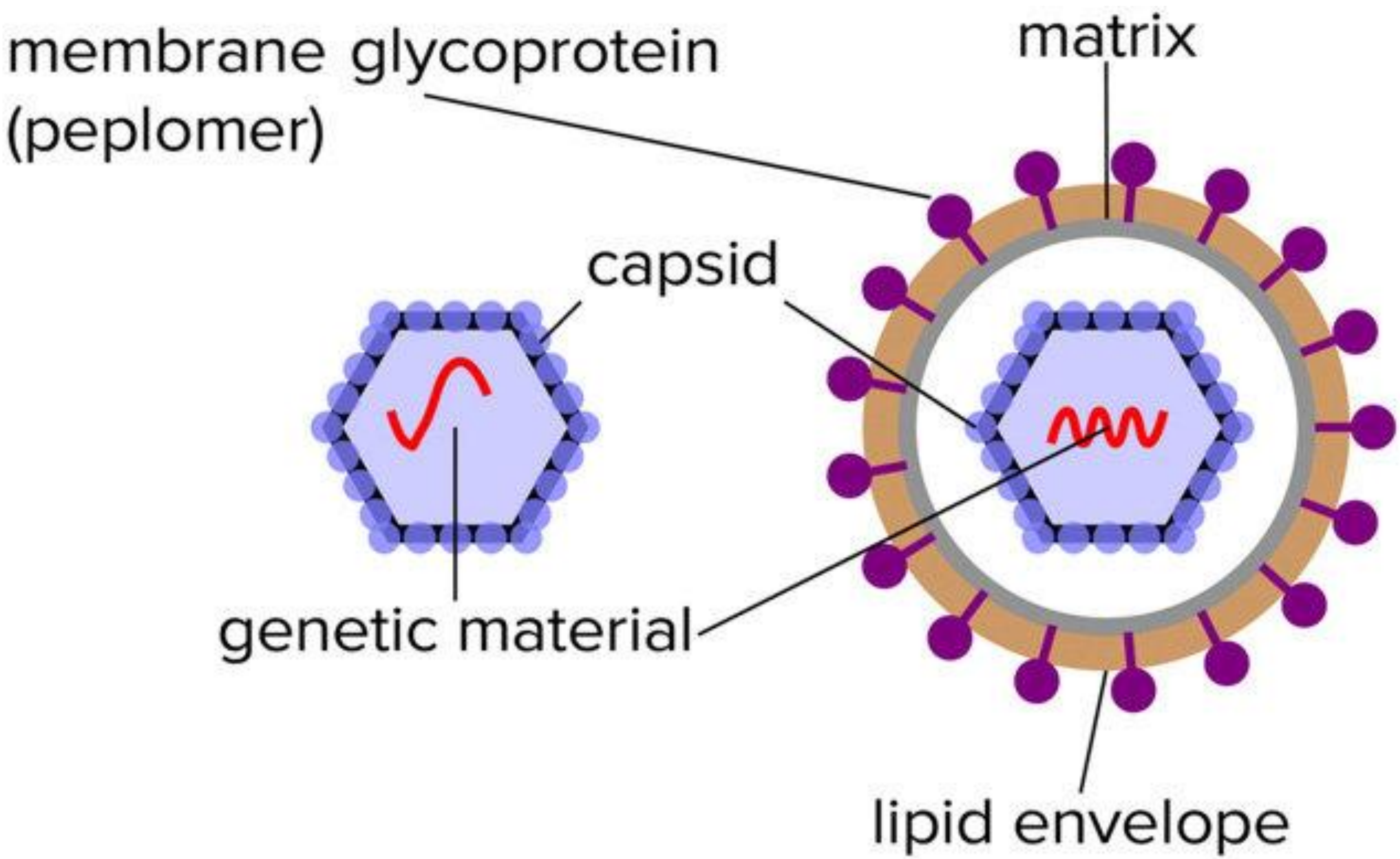


Melamine

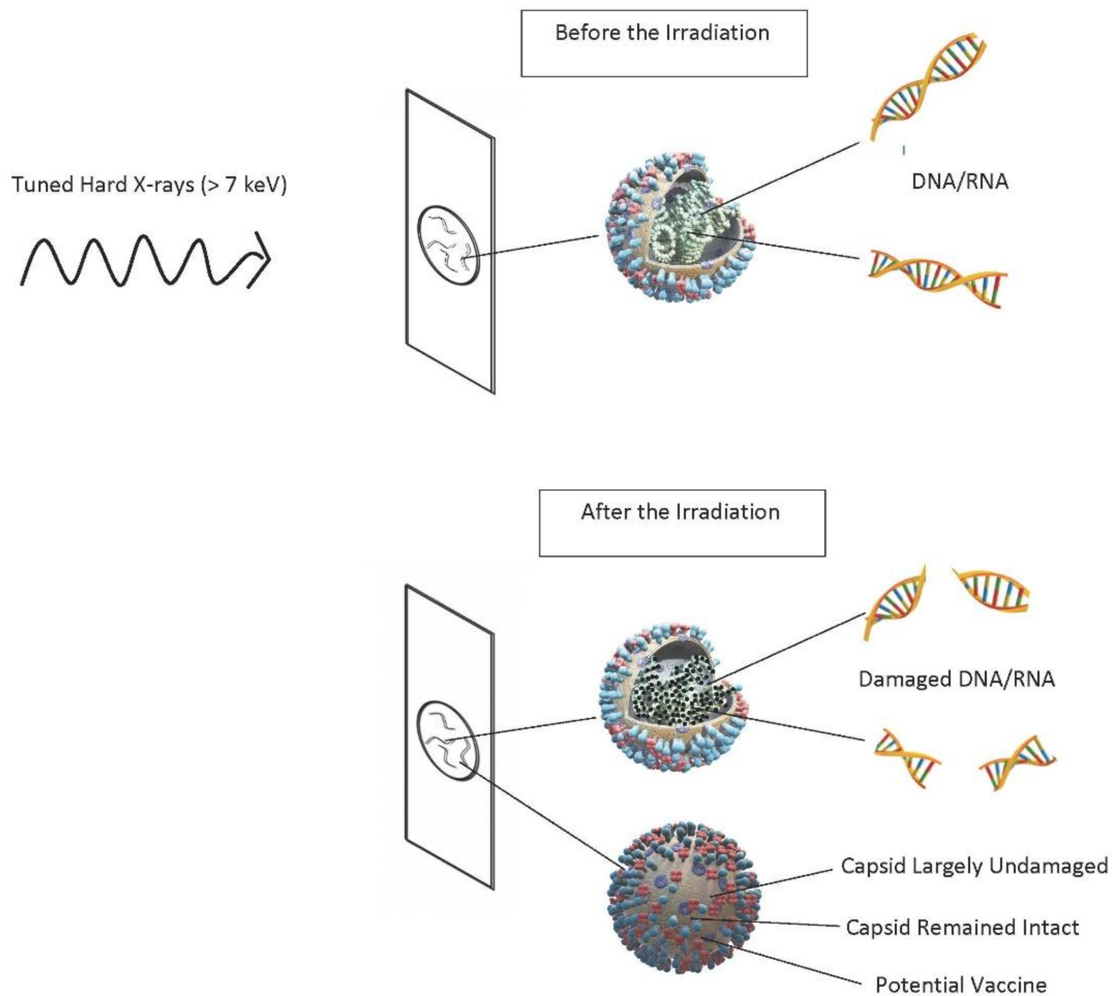




Virus schematic



Patent application: VACCINES PRODUCED USING HARD X-RAYS



RadTown
CONTACT US

Mail Irradiation

Radiation Facts

Irradiated mail is passed through a high energy beam of electrons or x-rays.
Irradiation sterilizes mail; it does not make mail radioactive.
Mail irradiation can damage plastics and make paper brittle.
Mail irradiation is a technique that is used on mail addressed to certain government agencies to ensure that packages and letters do not contain harmful bacteria. Postal workers that use mail irradiation equipment are kept safe by strict controls throughout the process.

On this page:

About Mail Irradiation

In October 2001, the infectious disease anthrax was found in mail sent to several news agencies and the offices of two United States Senators. Anthrax is a species of bacteria (scientific name: Bacillus anthracis) that forms spores, which when inhaled, can make people sick. It is very rare that you would come in contact with anthrax during normal daily activities. However, after the anthrax mailings in 2001, the U.S. Postal Service began to irradiate mail addressed to certain government agencies. This was done with help from the Federal Bureau of Investigation (FBI) and public health experts.

Irradiating mail can make it dry, brittle or discolored.
During the irradiation process, mail must pass through a high energy beam of ionizing radiation in order to kill harmful bacteria. The beam penetrates deep into the mail to destroy viruses and bacteria—like anthrax. Mail irradiation can also be used on thicker postal materials like letter trays and packages.

The ionizing radiation used in the mail irradiation process can cause chemical changes in paper. The mail might come out brittle and discolored, looking and smelling like it has been baked in an oven. Irradiation also might turn plastics brown and warp CD cases or other plastic storage containers. Even though it causes physical changes, irradiating mail does not make the mail radioactive.

Radiation levels are closely monitored at mail irradiation facilities to ensure that workers are safe. The facilities have thick concrete or lead lined walls to shield employees and visitors from radiation.

What You Can Do

There are no radiation concerns with handling irradiated mail. Irradiation does not make the mail radioactive.

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Future Plans

- Surface Enhanced Raman Spectroscopy
- Demonstration of enhancement collection idea for fiber optics and remote detection
- Fluorescence detection
- Visit of DHS border facility
- Visit of CBTS
- Design of portable remote detection UV/Vis + Raman system

CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

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Acknowledgements:

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DHS
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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

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Progress Report

1. **We are developing a hybrid Raman and UV/Vis spectrometer for rapid detection of some threats.**
2. **We have some ideas to share.**
3. **We are also developing ideas pertaining to eradication of immediate threats.**

We examined 4 types of threats:

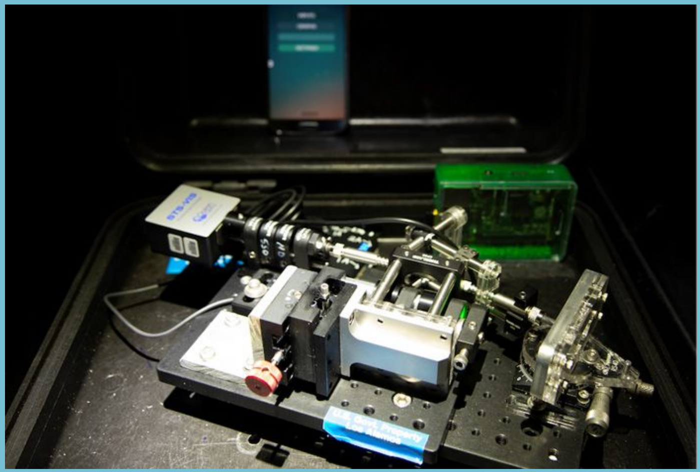
a. **Viral (Tobacco Mosaic Virus/TMV)**
b. **Bacterial (K12 Ecoli)**
c. **Mold (Yeast)**
d. **Chemical/poison (ibuprofen, acetaminophen, children's aspirin,**
e. **pure aspirin, nicotine)**

CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

There are largely two types of detection strategies:

A. Detection via chemical alteration/reaction (e.g. PCR); i.e ACTIVE
B. Detection via minimal or no chemical alteration (e.g. Raman/IR); i.e. PASSIVE

ACTIVE examples:



https://www.lanl.gov/discover/news-release-archive/2021/April/0422-pegasus-biosensor.php

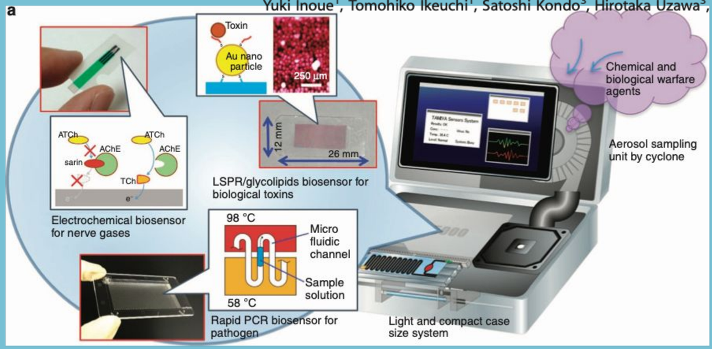
OPEN

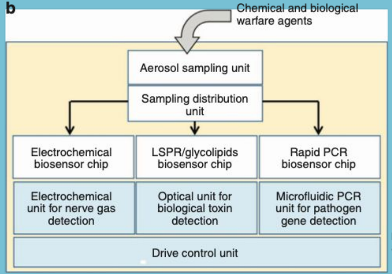
Microsystems & Nanoengineering (2018) 4, 17083; doi:10.1038/micronano.2017.83
www.nature.com/micronano

ARTICLE

Field-deployable rapid multiple biosensing system for detection of chemical and biological warfare agents

Masato Saito[1,2], Natsuko Uchida[3], Shunsuke Furutani[2,4], Mizuho Murahashi[1], Wilfred Espulgar[1], Naoki Nagatani[5], Hidenori Nagai[2,4], Yuki Inoue[1], Tomohiko Ikeuchi[1], Satoshi Kondo[3], Hirotaka Uzawa[3], Yasuo Seto[6] and Eiichi Tamiya[1]





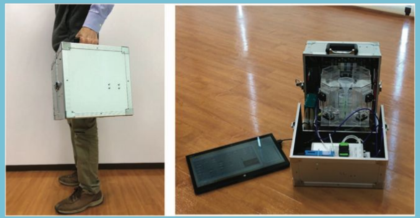


Figure 6 Prototype of the integrated automated portable device. All parts of the device are assembled in a compact 300 mm × 300 mm × 300 mm and 12.8 kg container. The device runs with a 24-V battery power source and is connected to a tablet screen.

Figure 1 (**a**) Scheme of our concept of the on-site device system for evaluating the presence of chemical and biological warfare agents rapidly and with high sensitivity. This system works autonomously from air sampling to detection by integrating the air-sampling unit based on cyclone technology and detection system units using biosensor chip device technologies, such as electrochemical measurement, LSPR, and on-chip PCR. In addition, the system is lightweight and compact in size for portability. (**b**) System composition. Initially, chemical and biological warfare agents in the air are harvested into the aerosol-sampling unit. The collected sample solution is distributed to separated biosensor chips and then measured. All units are operated by the control unit. Note that the parts indicated in the white-colored boxes are considered disposable. ATCh, acetylthiocholine; AChE, acetylcholinesterase; LSPR, localized surface plasmon resonance; TCh, thiocoline.

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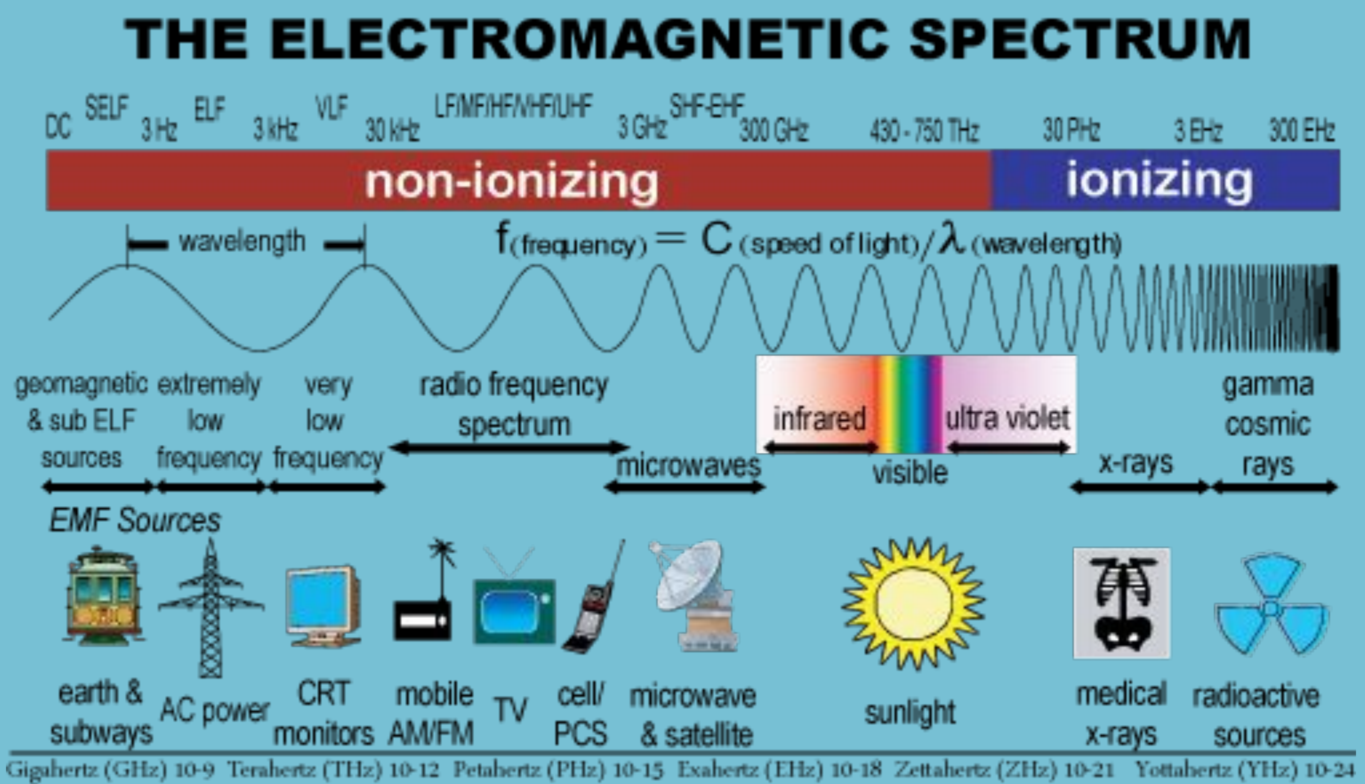
Factors to consider/boundary conditions:

1. **Does the interrogation method damage the sample?**
2. **Is it dangerous to the operator?**
3. **How much training is required for the operator?**
4. **How long does it take to perform?**
5. **Expense**
6. **Reliability/ruggedness of equipment**
7. **Possibility for remote detection?**
8. **Reagents/chemicals/repeated measurements/supplies**
9. **Measurements in extreme conditions (e.g. high temperature)**

We decided to focus on PASSIVE/spectroscopic methods for rapid testing.



Energy (eVs)→

https://socratic.org/questions/what-is-the-electromagnetic-spectrum-used-for

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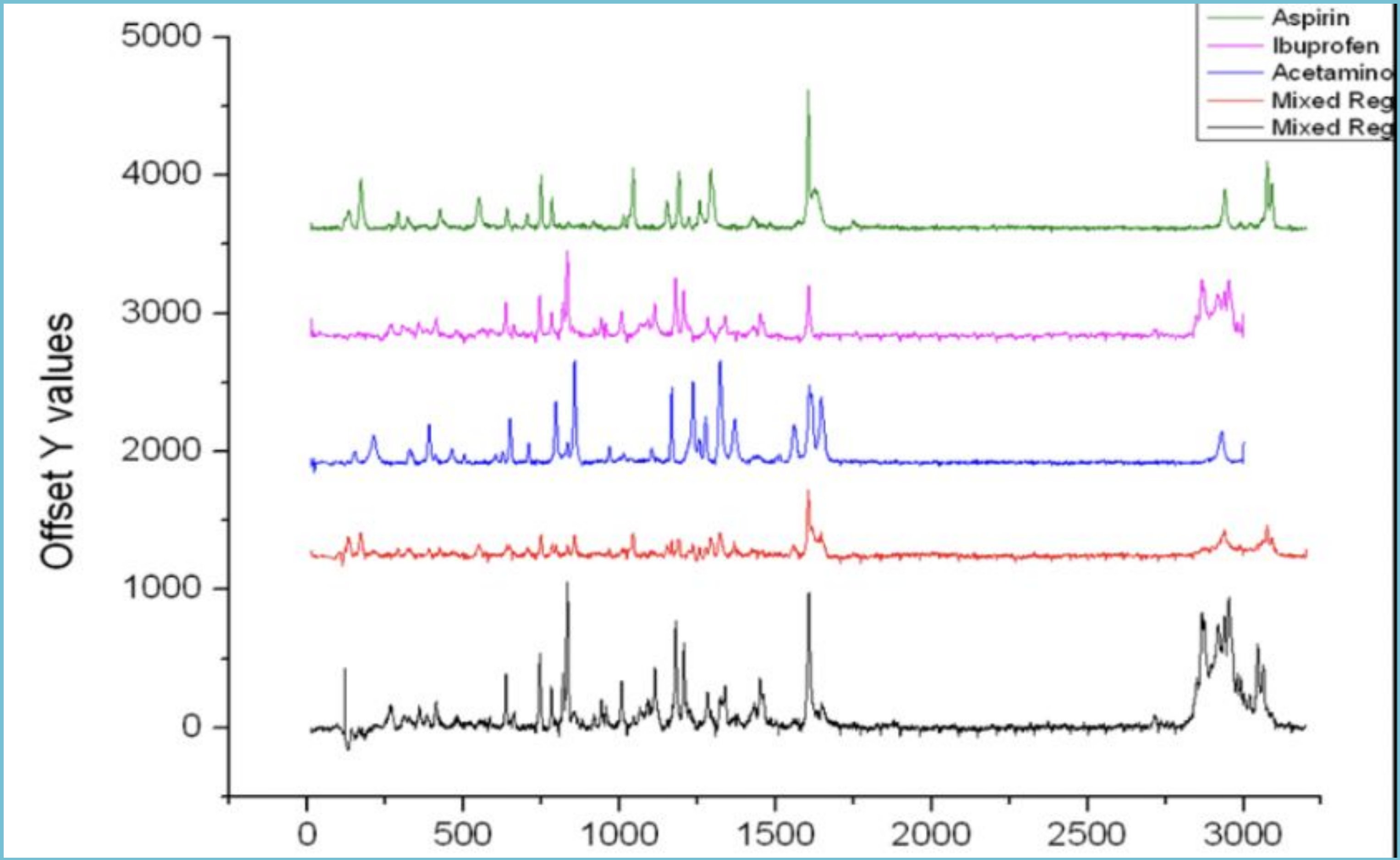
Spectroscopic methods we tried:

1. **Raman spectroscopy**
2. **UV/Visible absorption spectroscopy**
3. **NMR**
4. **Cyclic voltammetry**
5. **Fluorescence spectroscopy**

Raman Spectra



Raman spectra of aspirin (top), acetaminophen (2nd from top), and ibuprofen (3rd from top) powders. The lower 2 traces are Raman spectra of various mixtures of these 3 constituents.

UV/Vis absorption spectra

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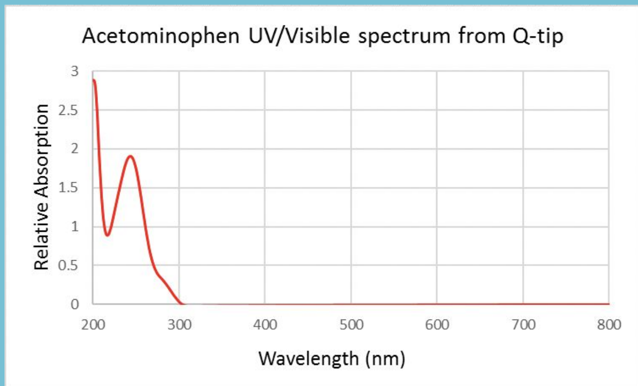
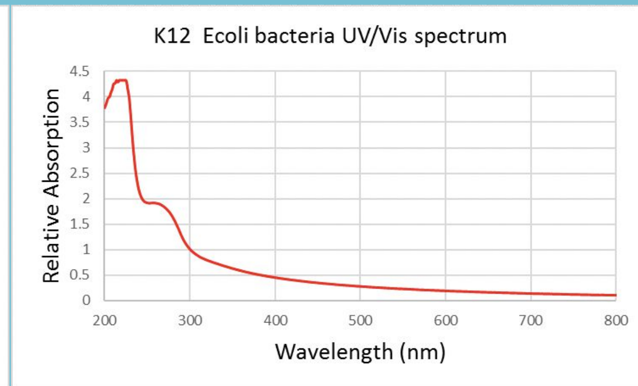
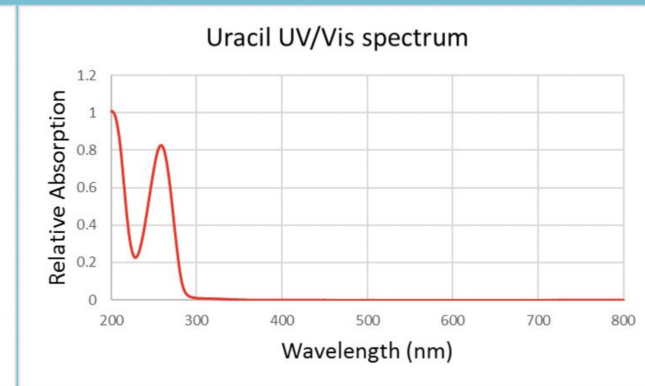
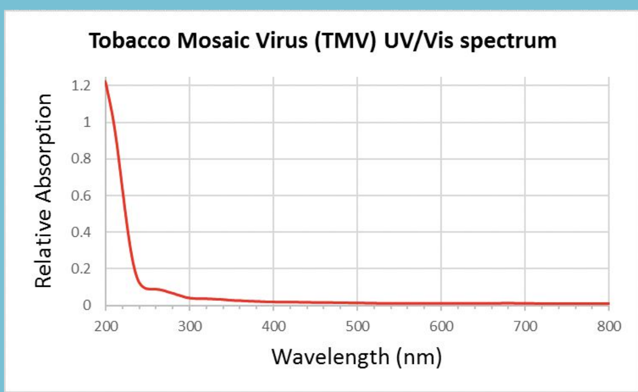
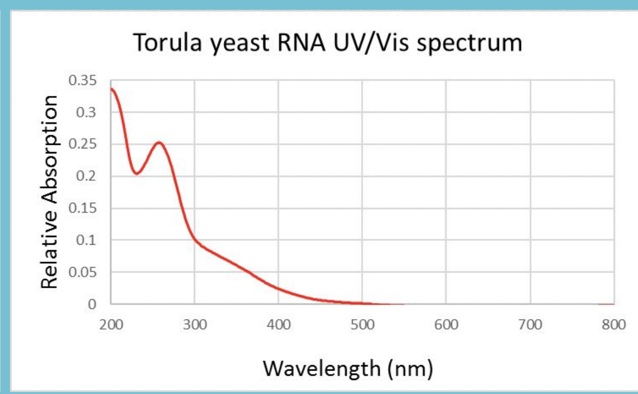
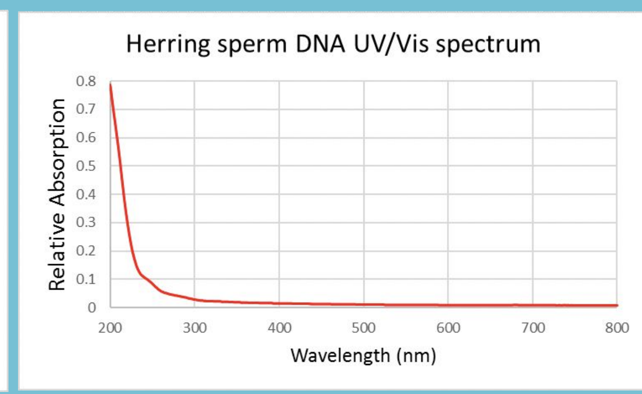




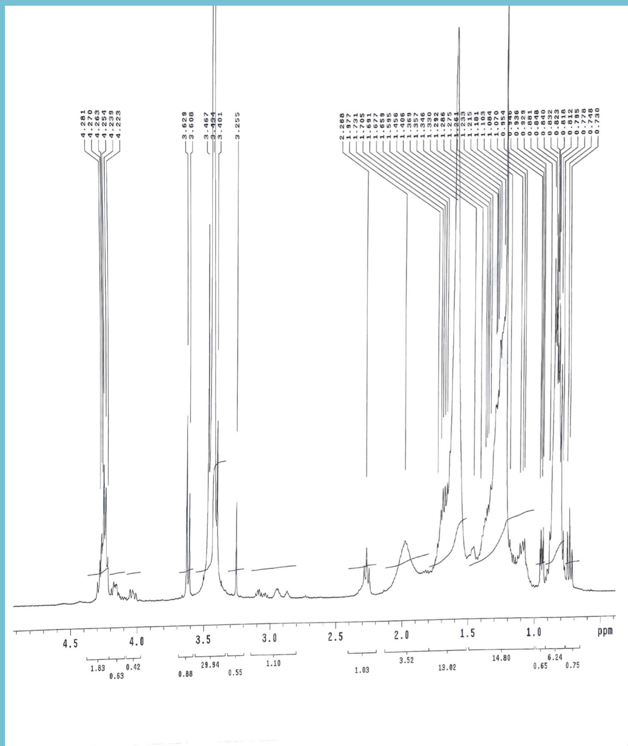


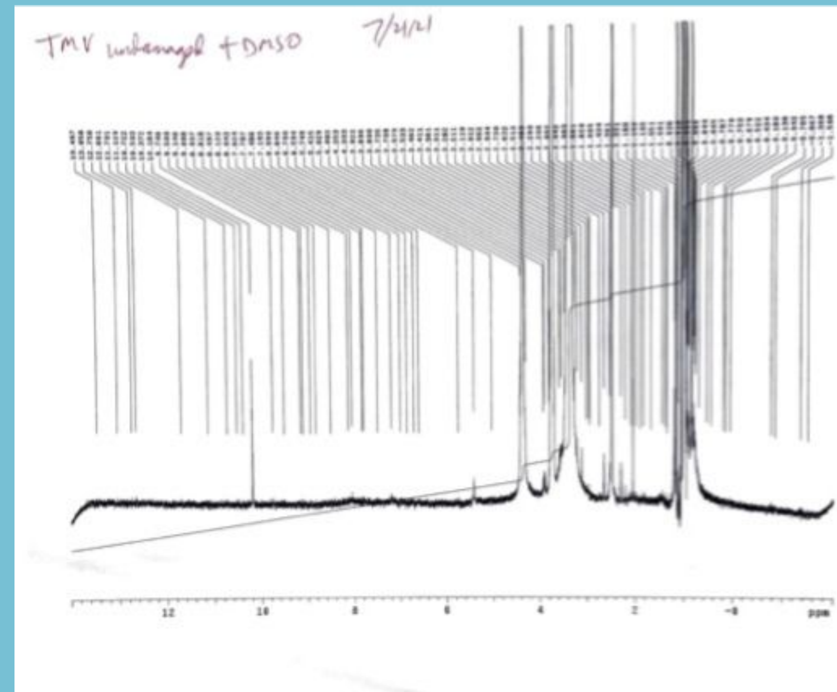






NMR Spectra



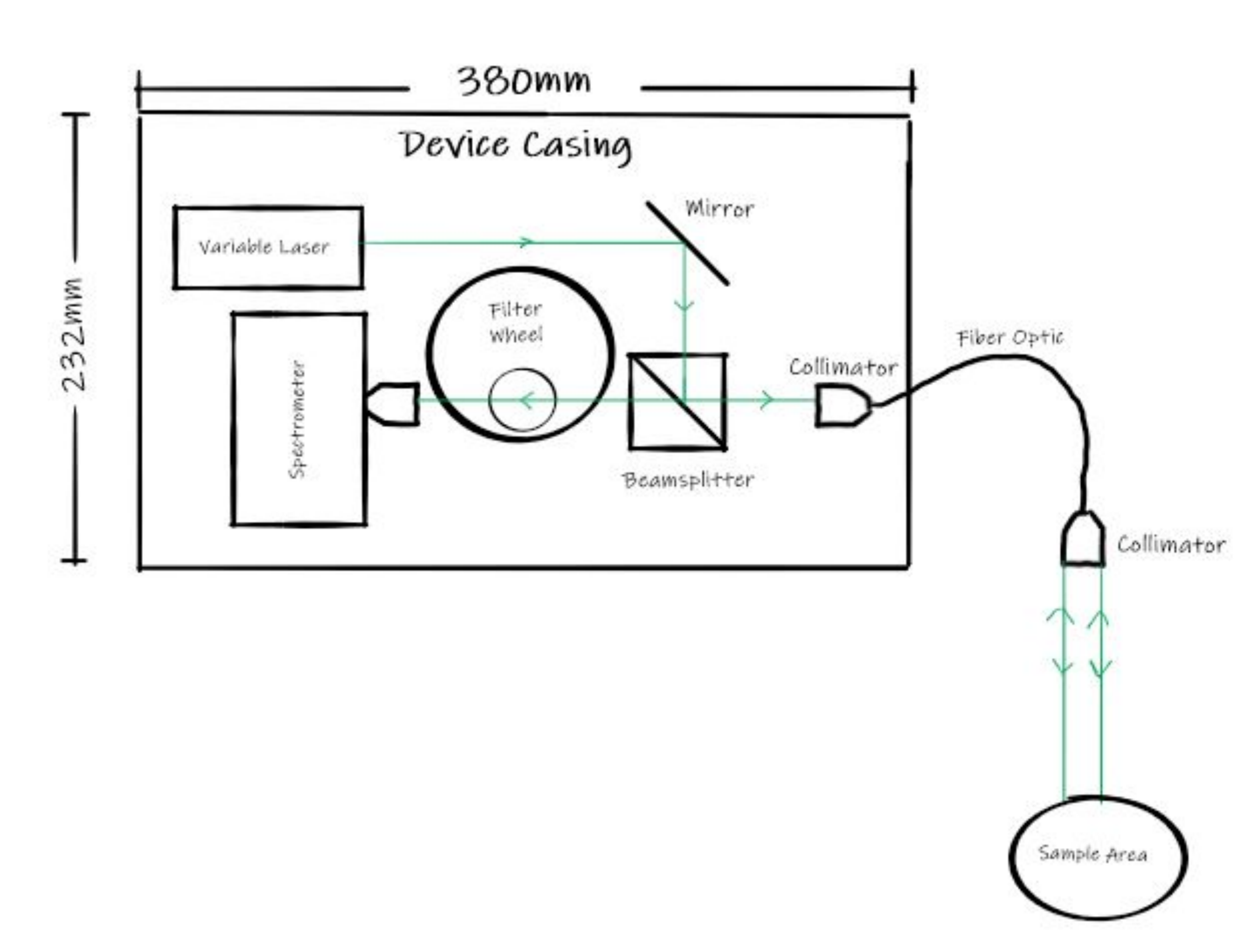


Proton NMR spectra of yeast (left) and TMV (right).

One suggested approach:

Raman→UV/Vis→NMR→ACTIVE

Proposed setup (sketch):



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Portable Raman spectrometer (example)

Technical Information

smiths detection
bringing technology to life

ACE-ID™

NON-CONTACT EXPLOSIVES & NARCOTICS IDENTIFIER WITH ORS TECHNOLOGY

Feature Highlights

- **Rapidly identifies solids, liquids, gels and powders**
- **Proprietary mixture analysis software enables identification of up to two components within sample**
- **Integration software kit for remote operation and report generation**
- **Compact, robust and lightweight**
- **Orbital Raster Scan (ORS) technology diffuses laser energy to reduce the risk of heating samples and igniting energetic materials**
- **MIL-STD-810G compliant for rugged use in harsh conditions and operation in extreme temperatures (-20C to +50C)**

ACE-ID is a next-generation, handheld Raman identifier for explosives and narcotics that analyzes solids, powders, liquids, and water based solutions as well as performs mixture analysis.

Utilizing Raman spectroscopy, ACE-ID enables non-contact analysis, yielding rapid results in seconds. Materials can be identified through translucent and semi-translucent containers such as plastic and glass. In addition, analysis is also supported by a software kit for remote operation.

ACE-ID is MIL-STD-810G compliant for rugged use in harsh conditions and operation in extreme temperatures (-20C to +50C). It is lightweight and can be operated with just one hand.

An intuitive software interface guides users through the entire identification process making it easy-to-use with minimal training.

ACE-ID utilizes an advanced Orbital Raster Scan (ORS) optical platform to diffuse laser energy, reducing the risk of heating samples and igniting energetic materials. It also provides operation using an off-the-shelf lithium battery.

ACE-ID is backed by ReachBackID™, a first-rate 24/7/365 service and support program to ensure optimum product performance.

ACE-ID is a product from Smiths Detection, a leading worldwide provider of government regulated technology products and advanced services that aid in the detection and identification of chemical, biological, radiological, nuclear and explosive (CBRNE) material and other dangerous or illegal substances.

www.smithsdetection.com

Technical Data **ACE-ID**

General Specifications	
Technology	Raman
Size	12.7 x 8.9 x 5.6 cm (5 x 3.5 x 2.2 in)
Weight	0.45kg (1lb)
Sampling	Point and shoot
Library	Approximately 500 substances consisting of explosives, precursors, narcotics, and toxic chemicals
User library	Ability to add user defined samples via laptop
Start-up time	Less than 20 sec at 20°C (68°F)
Detection time	Less than 20 sec at 20°C (68°F)
Power	One lithium battery (CR123A) or USB power source
Display	Touchscreen display (compatible with level A PPE gloves)
Connectivity	Micro USB
Operating temperature	-20°C to +50°C (-4°F to 122°F)
Storage temperature range	-40°C to +70°C (-40°F to 158°F)
Operating humidity	>95%
Color	Olive drab


Fast and easy analysis of multi-layered liquids, no sampling required.


Ergonomically designed for one handed operation with touchscreen interface.

Orbital Raster Scan (ORS) technology diffuses laser energy, reducing the risk of heating samples and igniting energetic materials.

CAUTION
INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
55 mW max at 785 nm
Complies with FDA performance standards except for deviations pursuant to Laser Notice No. 50: June 24, 2007
EN/IEC 60825-1 Ed. 2.0 (2007)

For product information, sales or service, please go to www.smithsdetection.com/locations

Smiths Detection, 2202 Lakeside Blvd, Edgewood, MD 21040 USA

smiths detection

CBTS Presentation
October 27, 2022

CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

Portable UV/Visible spectrometer (example)

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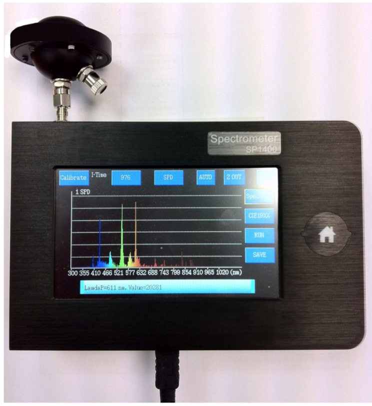
ABOUT US +1-800-253-4107

Products / Portable Spectrometer UV-VIS with LCD screen



Portable Spectrometer UV-VIS with LCD screen

US $ 3,000.00

Slit Width

10 (um)

Spectral Range (nm)

250~800nm

1

ADD TO CART

ADD TO COMPARE ADD TO WISHLIST

- USB2.0 or can be used without computer
- Robust Aluminum Housing
- SD card slot
- LCD screen 4.3 inches
- Replaced by SRI2000-UV

Description

ABOUT US +1-800-253-4107

This completely independent and portable spectrometer comes with a full LCD screen and built in analysis software making it possible to make measurements at any location. It also has batteries, no local power supply is required.

Data from either measurements or analysis can then be loaded onto flash memory or plugged straight into your computer for further evaluation at a later stage. Applications for this novel type of spectrometer include:

- Spectroscopy
- Absorption measurements
- Reflectance measurements
- Light source testing (e.g. LEDs)
- Detection of saccharic acids in food
- Taste analyzers
- Fluorescence measurement
- Industrial color measurement
- Tooth decay analysis
- Semiconductor inspection
- Chromatography
- DNA analysis

Additional Features

- mini-USB cable provided
- 4 AA batteries
- Compatible with Window XP, Vista, Windows 7
- SMA male fiber connector
- Including: USB cable, Software and DLL
- I/O external

Items	Specifications	Items	Specifications
Spectral Resolution	1.3 ~ 5.0 nm FWHM (varies by configuration)		
Wavelength Range	300-1000nm, 250-800nm, 380-760nm,700-1100nm, see table		
LCD Size	4.3 inches	Size	148(W) x 98.5(D) x 31.4(H) mm
A/D	16bits		
Interface	USB 2.0 or SD card		
Power supply	Battery or USB powered		

CBTS Presentation
October 27, 2022

CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE

Portable NMR/benchtop spectrometer (example)

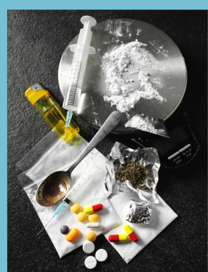
Case Study

Rapid screening of street drugs by benchtop NMR

The spread of illicit drugs has become a global problem, not only causing direct harm to people's physical and mental health, but also seriously affecting social and economic development. In addition to traditional drugs, many new psychoactive substances (NPS) have appeared in recent years, and they are becoming increasingly popular. New psychoactive substances are also known as "designer drugs" or "laboratory drugs". To avoid prosecution, criminals artificially design and modify the chemical structure of controlled drugs to obtain new types with effects similar to or even stronger than those of the controlled drugs. Due to the "new structure" of these substances, some traditional detection methods have become invalid, presenting great challenges to the drug prevention and control work of the whole society.

Fast drug screening without expert operators

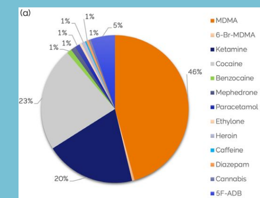
Nuclear Magnetic Resonance (NMR) technology can provide information on the connection of chemical molecular frameworks. It is the most direct tool for compound structure identification and can be used as an effective means to detect and identify new psychoactive substances. However, because traditional high-field superconducting NMR spectrometers have special requirements for operation and location, and because of the high cost of instrument use and maintenance, the application of NMR technology in rapid street drug screening is limited. In response to the above problems, Oxford Instruments has provided a new benchtop NMR solution for rapid drug identification. Oxford Instruments' X-Pulse benchtop NMR spectrometer uses rare earth permanent magnets, does not require liquid nitrogen, liquid helium or other refrigerants, is simple to operate and easy to maintain, and can quickly collect NMR spectra of suspicious drug samples.



Sample Match Criteria	Quantity	Percentage
Total number of samples analysed	**432**	
Unable to verify (GC-MS does not produce peaks)	13	3.0%
No API or admixtures	3	0.7%
Cannot match	4	0.9%
Correct match (single component sample)	374	86.6%
Correct match (two-component sample)	13	3.0%
Partial matching (two-component or multi-component samples)	25	5.8%
Verification of samples containing API or admixtures	**416**	
Exact match	387	93.0%
Exact + partial match	412	99.0%

Table 1. Analysis results of a batch of suspicious samples

A batch of suspicious samples seized by public security agencies was analysed by X-Pulse and gas chromatography-mass spectrometry (GC-MS) at the same time. The results are shown in Table 1. The total number of samples analysed was 432, of which 13 (3.0%) could not be verified by NMR due to there being no GC-MS peaks, and 3 (0.7%) contained no active ingredients (API) or admixtures. Among the remaining 416 samples that were confirmed to contain API or admixtures, 387 (93.0%) of the NMR and GC-MS test results were matched exactly. On this basis, if the partially matched samples are added, the total number reached 412 (99.0%). Of equal importance, no false positives were found. This data demonstrates that X-Pulse can detect and identify street drugs with high accuracy and reliability.



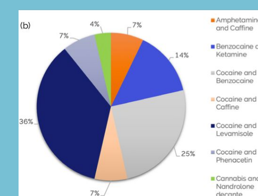


Figure 2. Types and quantities of street drugs detected by X-Pulse
(a) One-component compound; (b) Two-component mixture [1]

Identifying street drugs - data for judicial enforcement

Through comparison and matching with the X-Pulse drug database, it was found that more than 400 questionable samples contained a variety of different drugs. Among street drugs consisting of single-component compounds, the most often detected were ecstasy (MDMA), cocaine and ketamine; in the two-component mixture samples, cocaine/levamisole, cocaine/benzocaine, and other admixtures were mainly found (Figure 2). The results can provide valuable references for public security judicial identification agencies to understand the types and prevalence of local drugs, and to formulate corresponding control strategies and action plans.

References:

[1] Antonides LH et al., Rapid Identification of Novel Psychoactive and Other Controlled Substances Using Low-Field 1H NMR Spectroscopy, ACS Omega. 2019, 4: 7103-7112

[2] Mewis R et al., Quantification of MDMA in seized tablets using benchtop 1H NMR spectroscopy in the absence of internal standards, Forensic Chemistry, 2020, 20: 100263

Visit **nmr.oxinst.com**

CBTS Presentation
October 27, 2022

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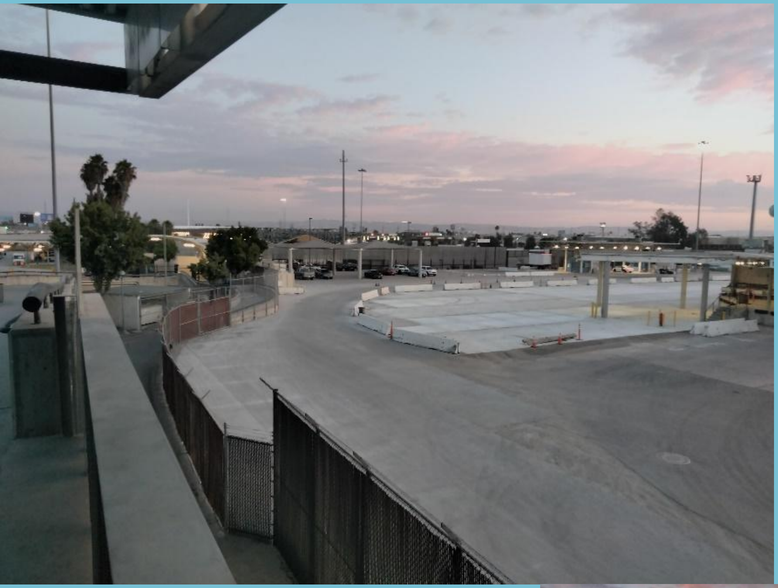
Visit to the San Ysidro and Otay Mesa DHS Border Facilities



CBTS Presentation
October 27, 2022

CROSS-BORDER
THREAT SCREENING AND
SUPPLY CHAIN DEFENSE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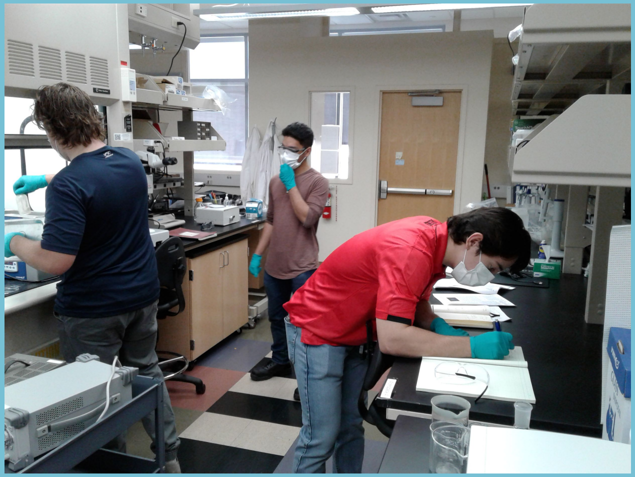
Merime Njegomir



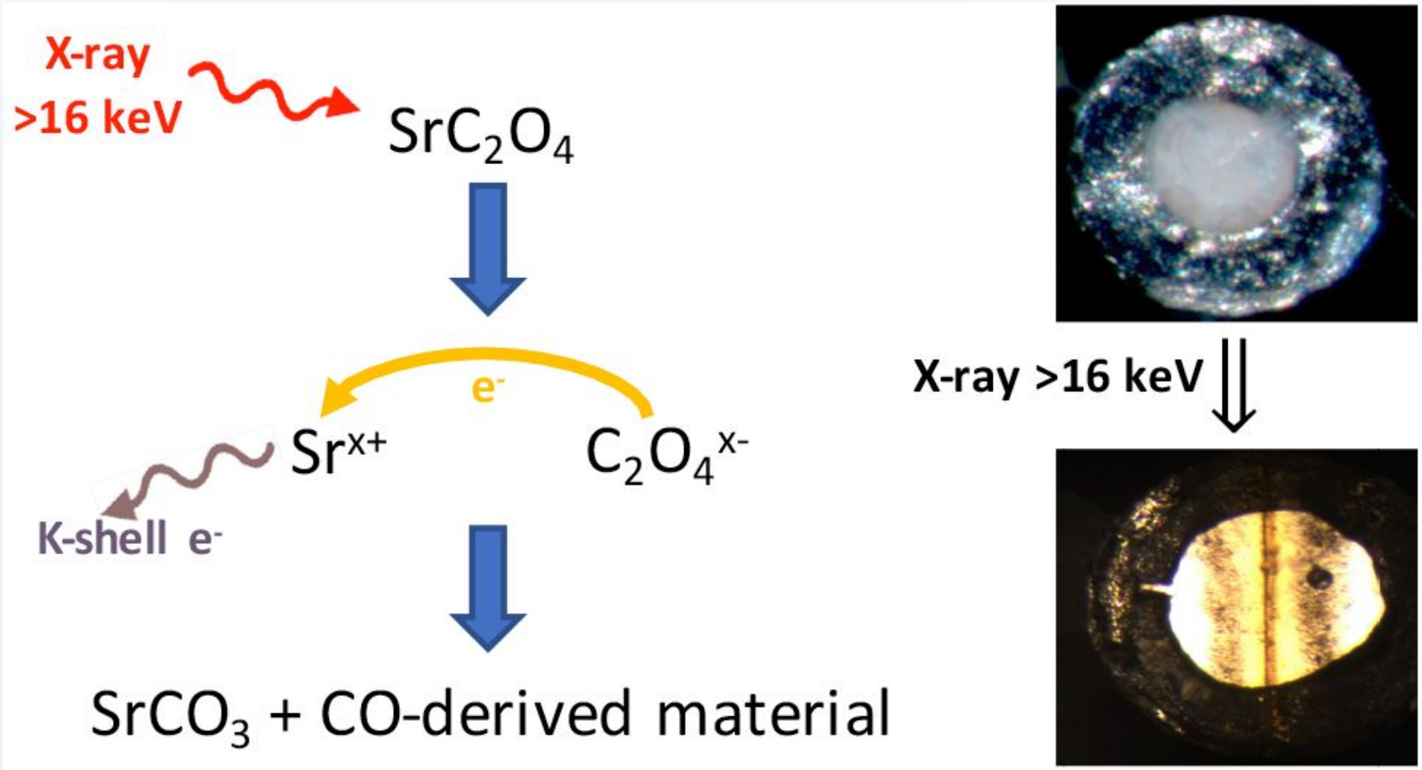
CBTS Presentation
October 27, 2022

Cross-Border Threat Screening and Supply Chain Defense


UNLV

Controlled/selected decomposition with monochromatic hard x-rays

Decomposition of materials using tuned hard x-rays.



THE JOURNAL OF PHYSICAL CHEMISTRY A
Article
pubs.acs.org/JPCA

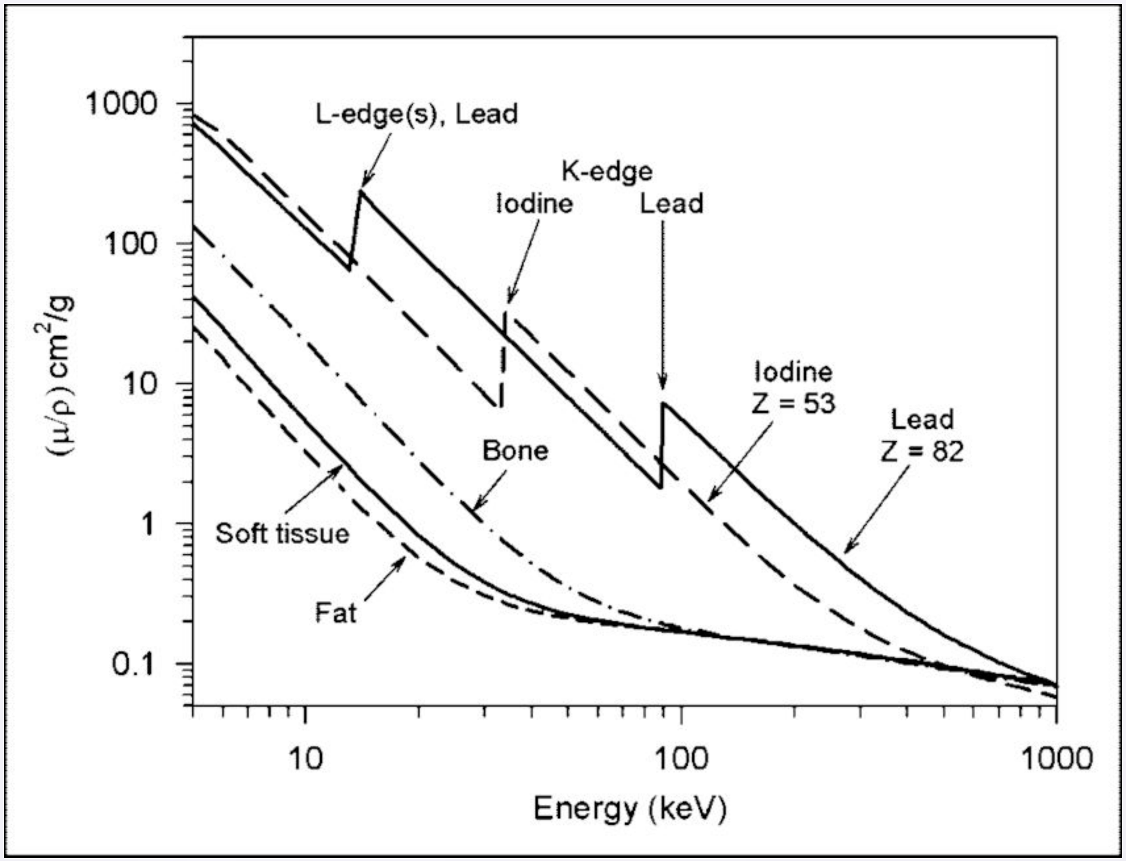
Measurement of the Energy and High-Pressure Dependence of X-ray-Induced Decomposition of Crystalline Strontium Oxalate

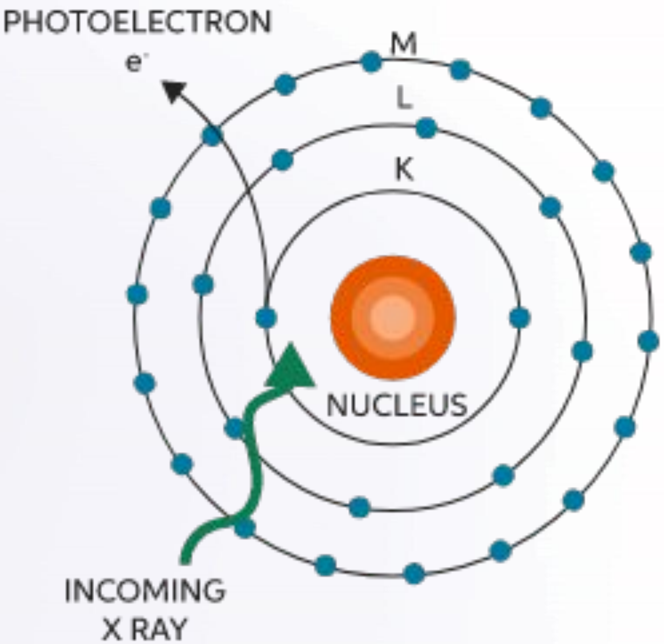
David Goldberger,[†] Egor Evlyukhin,[†] Petrika Cifligu,[†] Yonggang Wang,[‡] and Michael Pravica*[,†]

[†]High-Pressure Science and Engineering Center (HiPSEC) and Department of Physics, University of Nevada Las Vegas (UNLV), Las Vegas, Nevada 89154-4002, United States
[‡]HPCAT, Geophysical Laboratory, Carnegie Institution of Washington, 9700 South Cass Avenue, Argonne, Illinois 60437, United States

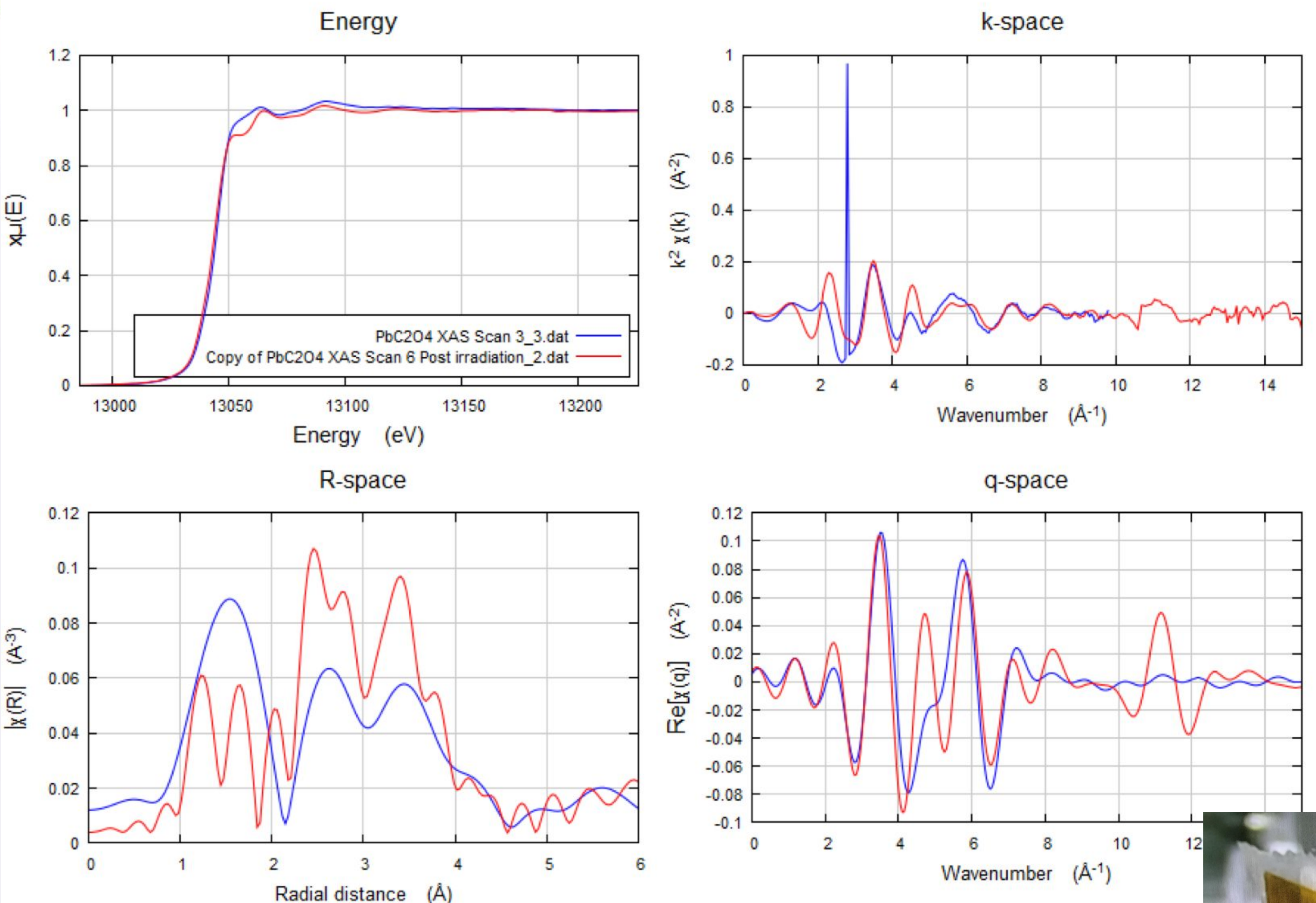
ICIP Talk
July 11, 2022

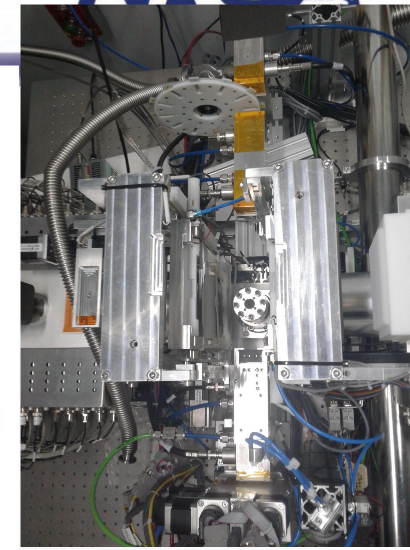
K-edge and L-edge absorption of x-rays

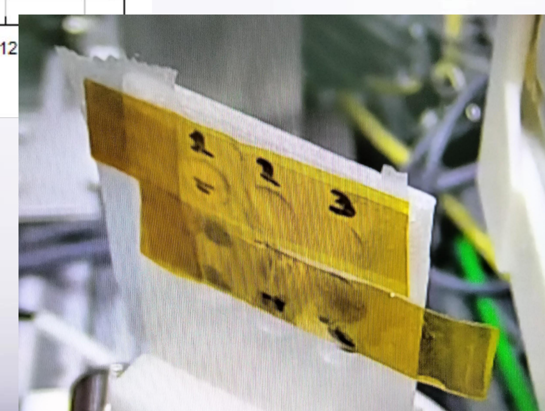




Evidence for L-edge induced chemistry







ICIP Talk
July 11, 2022

Observation of molecular decomposition “resonances” in the hard x-ray regime.

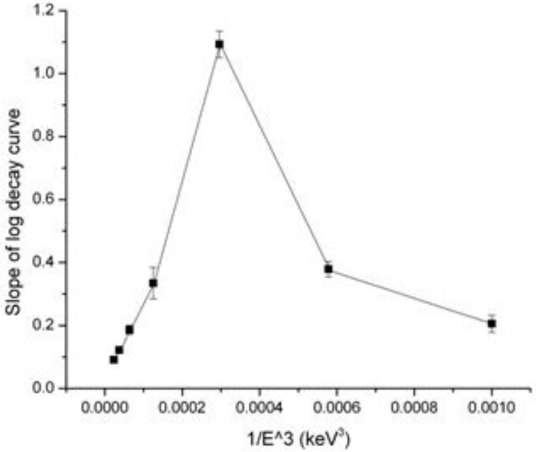
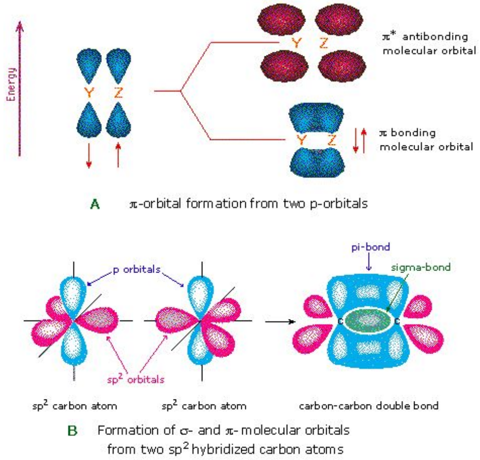
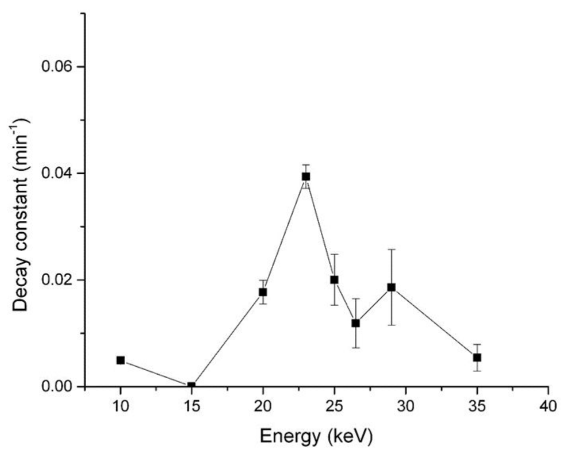
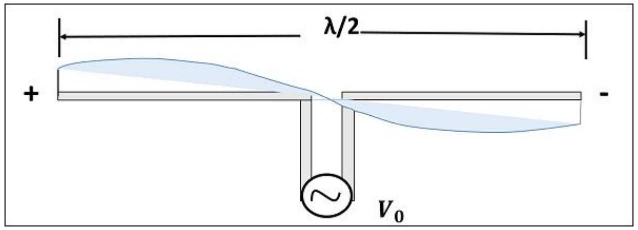


Fig 1: (Left): Schematic of x-ray irradiation of strontium oxalate just above the K-edge of Sr[6]. (Middle): photos of x-ray induced reaction of SrC_2O_4 (Right): X-ray induced decay of $KClO_3$ into KCl and O_2 as a function of x-ray energy.

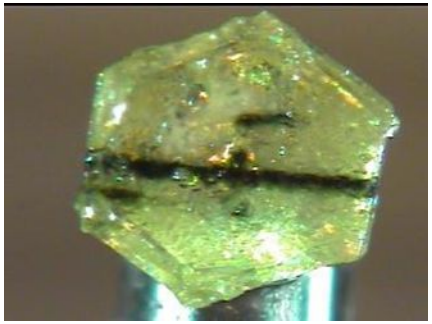


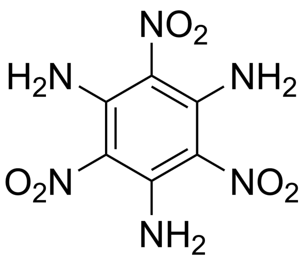




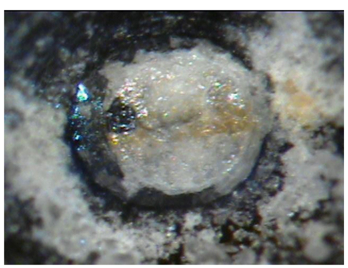
25 keV ~ 0.5 Å

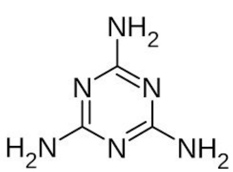
Nucleic acids and their incorporation into DNA/RNA



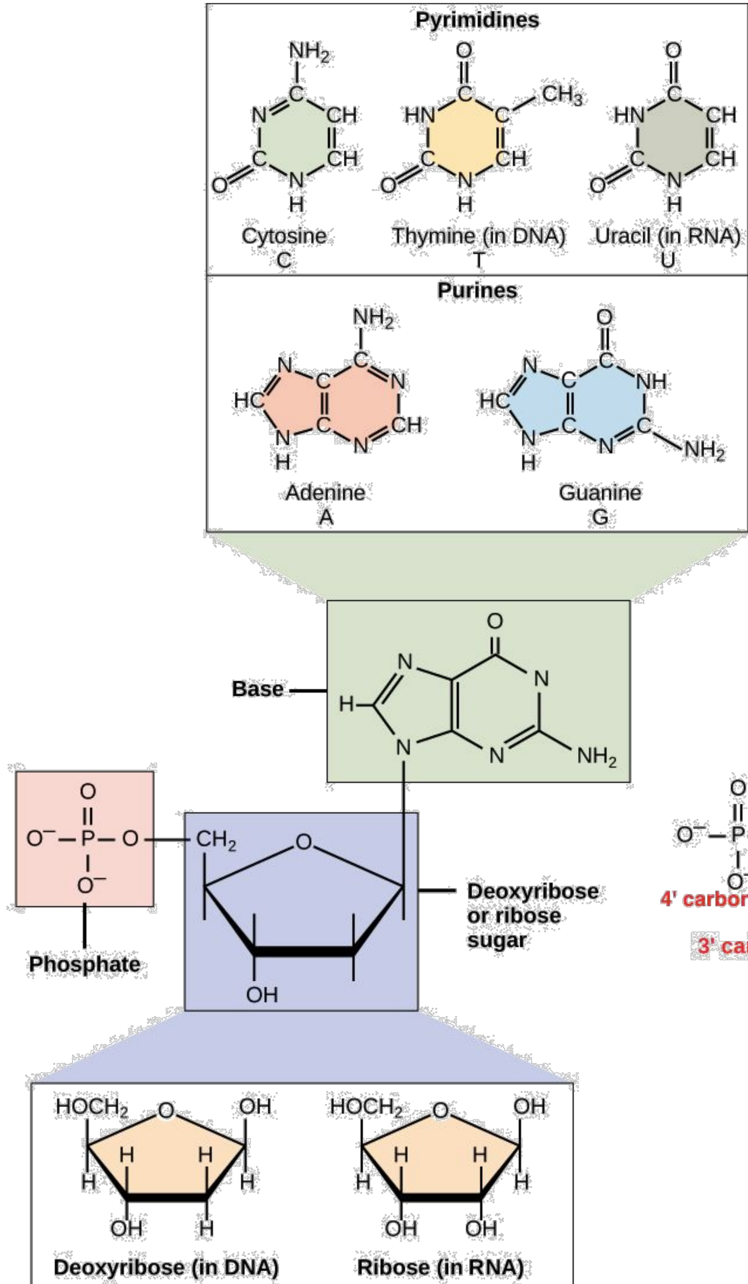


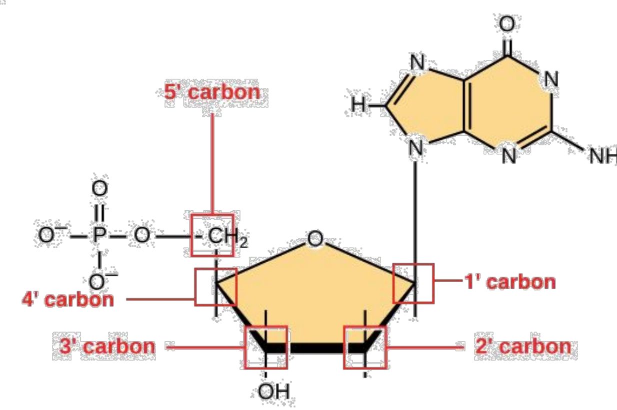
TATB



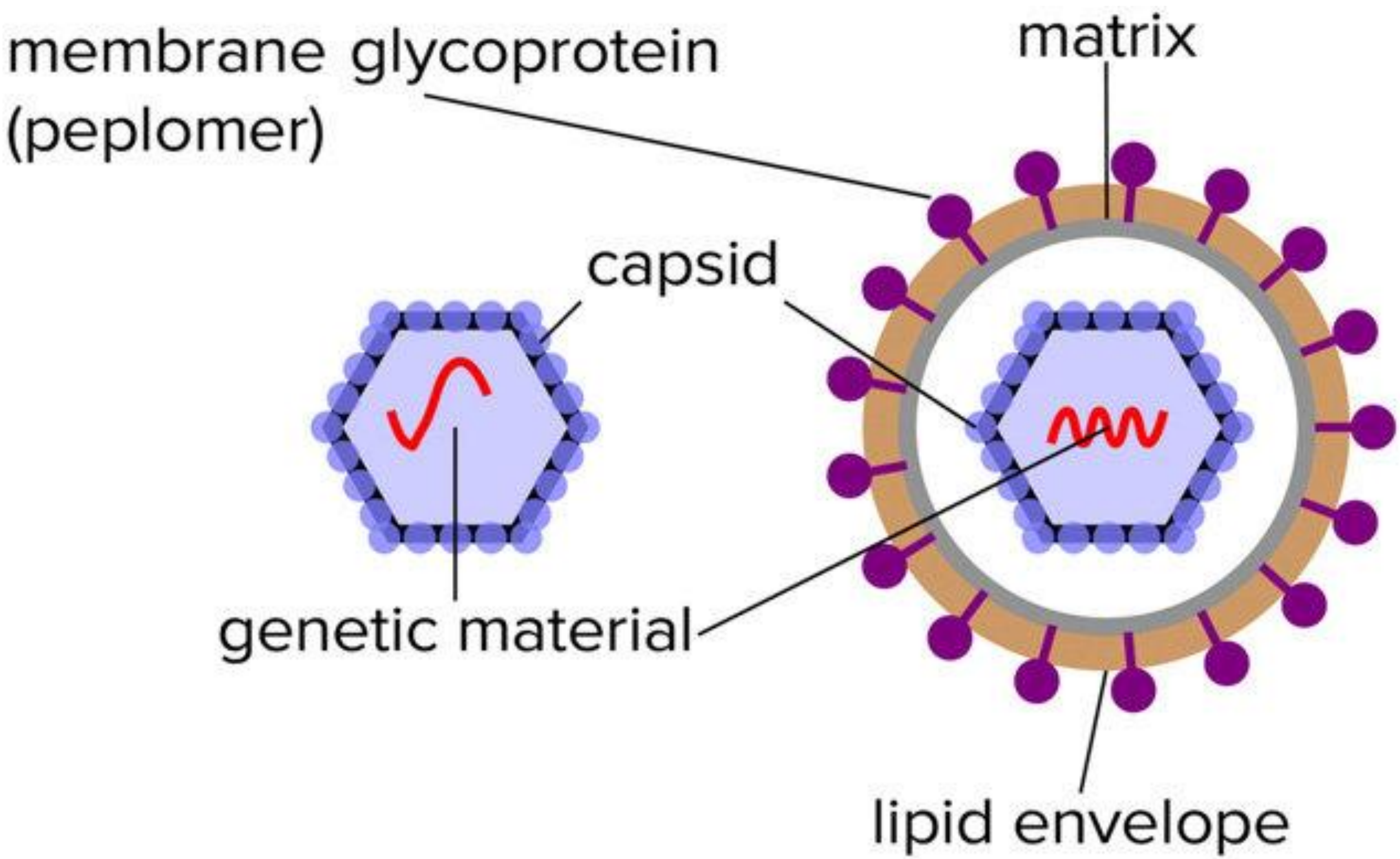


Melamine

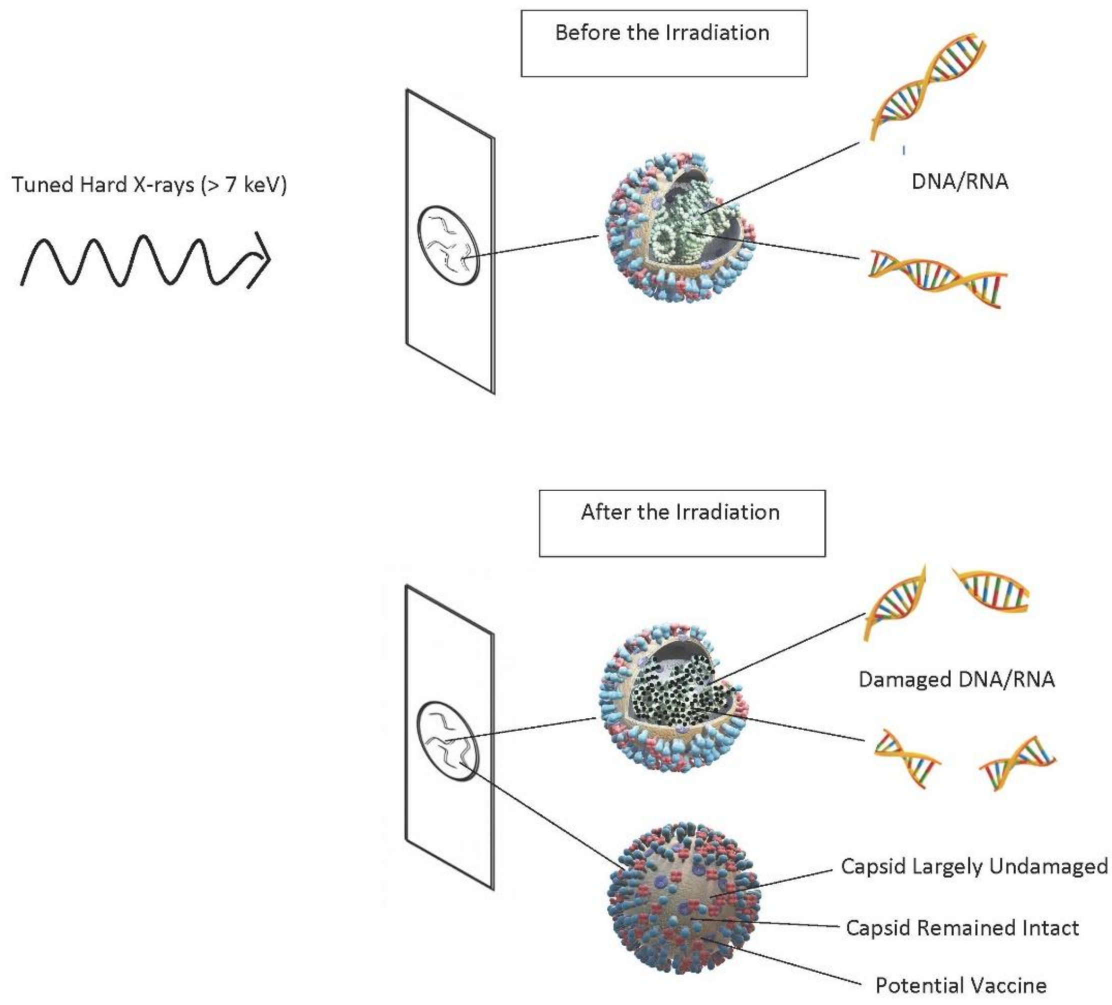




Virus schematic



Patent application: VACCINES PRODUCED USING HARD X-RAYS



RadTown
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Mail Irradiation

Radiation Facts

- Irradiated mail is passed through a high energy beam of electrons or x-rays.
- Irradiation sterilizes mail; it does not make mail radioactive.
- Mail irradiation can damage plastics and make paper brittle.

Mail irradiation is a technique that is used on mail addressed to certain government agencies to ensure that packages and letters do not contain harmful bacteria. Postal workers that use mail irradiation equipment are kept safe by strict controls throughout the process.

On this page:

About Mail Irradiation

In October 2001, the infectious disease anthrax was found in mail sent to several news agencies and the offices of two United States Senators. Anthrax is a species of bacteria (scientific name: Bacillus anthracis) that forms spores, which when inhaled, can make people sick. It is very rare that you would come in contact with anthrax during normal daily activities. However, after the anthrax mailings in 2001, the U.S. Postal Service began to irradiate mail addressed to certain government agencies. This was done with help from the Federal Bureau of Investigation (FBI) and public health experts.

Irradiating mail can make it dry, brittle or discolored.

During the irradiation process, mail must pass through a high energy beam of ionizing radiation in order to kill harmful bacteria. The beam penetrates deep into the mail to destroy viruses and bacteria—like anthrax. Mail irradiation can also be used on thicker postal materials like letter trays and packages.

The ionizing radiation used in the mail irradiation process can cause chemical changes in paper. The mail might come out brittle and discolored, looking and smelling like it has been baked in an oven. Irradiation also might turn plastics brown and warp CD cases or other plastic storage containers. Even though it causes physical changes, irradiating mail does not make the mail radioactive.

Radiation levels are closely monitored at mail irradiation facilities to ensure that workers are safe. The facilities have thick concrete or lead lined walls to shield employees and visitors from radiation.

What You Can Do

There are no radiation concerns with handling irradiated mail. Irradiation does not make the mail radioactive.

Future Plans

- Surface Enhanced Raman Spectroscopy
- Demonstration of enhancement collection idea for fiber optics and remote detection
- Fluorescence detection
- Visit of DHS border facility
- Visit of CBTS
- Design of portable remote detection UV/Vis + Raman system

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Shaping the Future of Science

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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE