



# ONSPEC SERIES

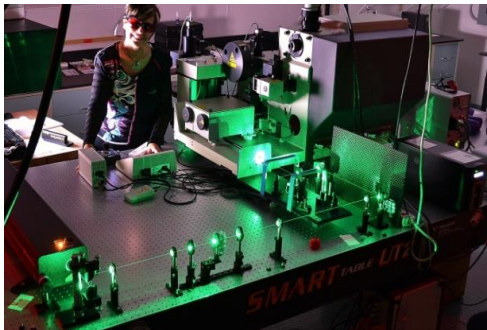
**NECTEC SERS substrates**

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National Electronics and Computer Technology  
Center (NECTEC), National Science and  
Technology Development Agency (NSTDA)

# Raman spectroscopy

## Classical system



## Modern Raman imaging system



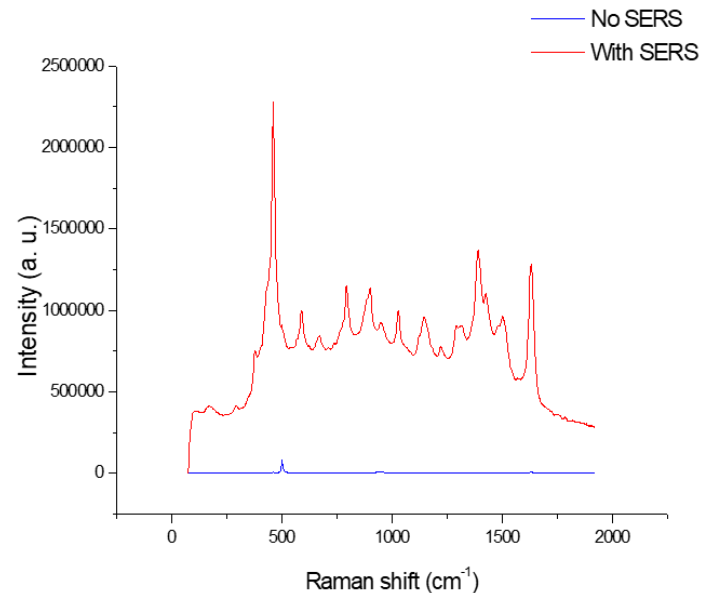
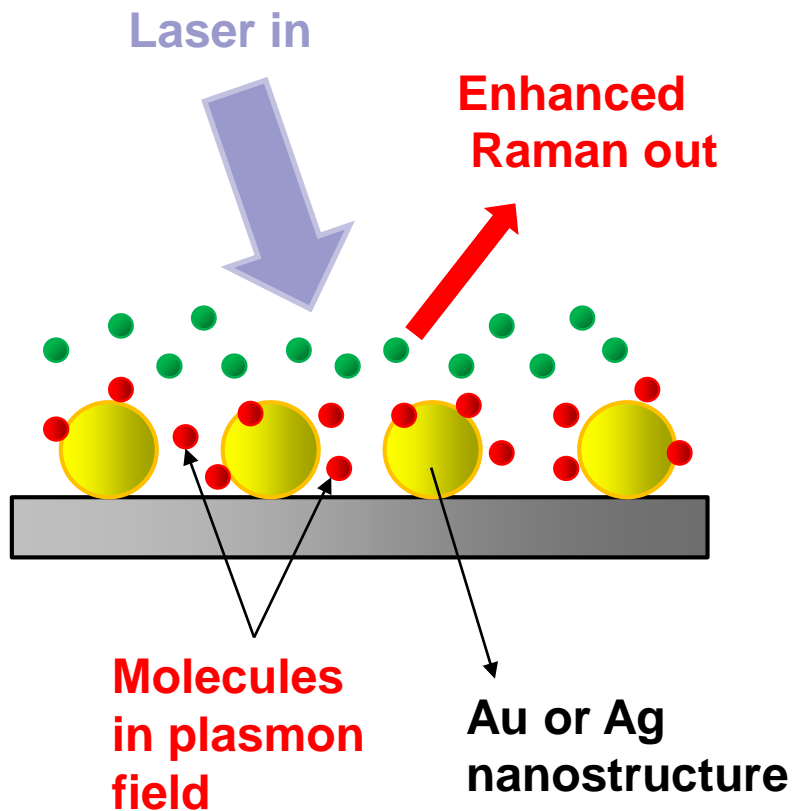
## Handheld Raman



# Surface-enhanced Raman scattering

*Improve sensitivity of Raman Spectroscopy!*

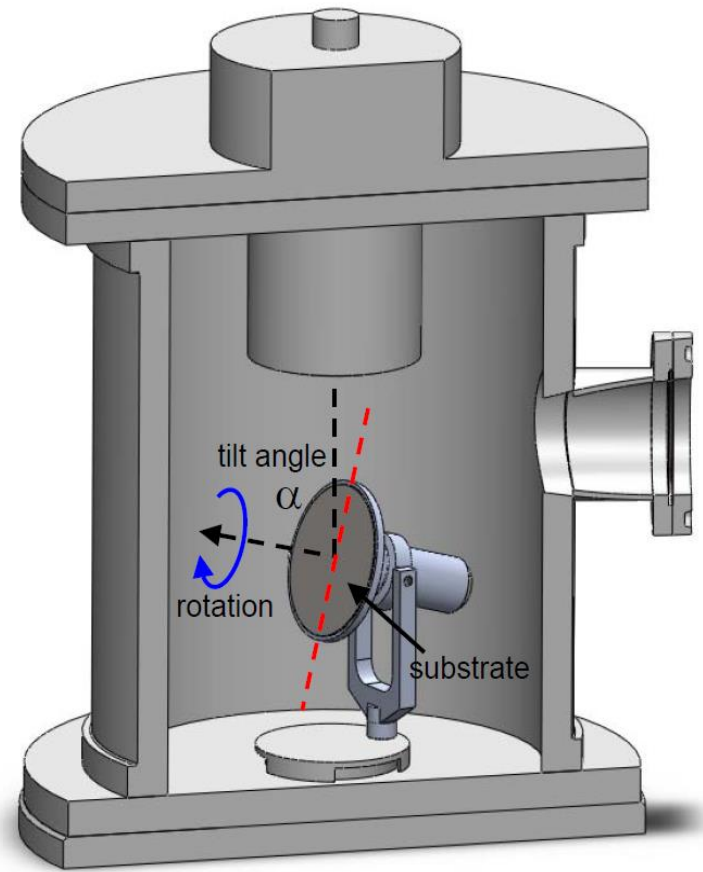
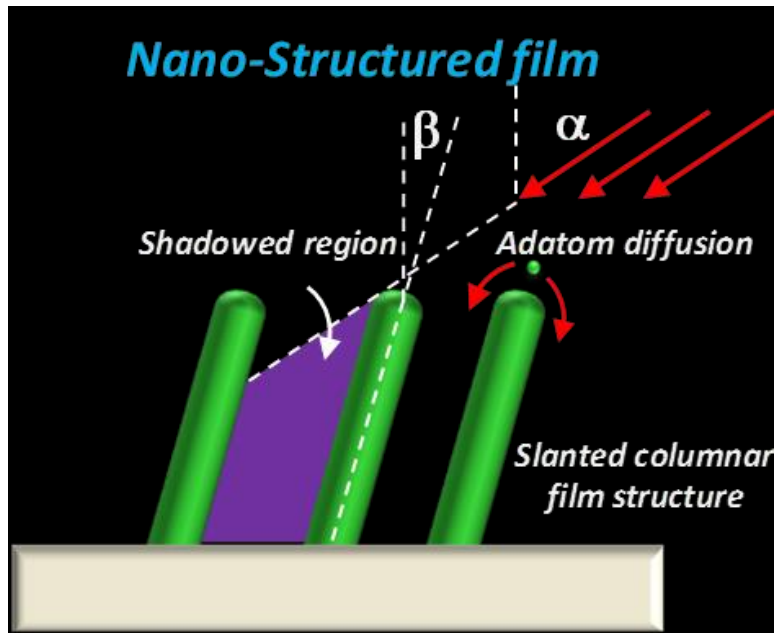
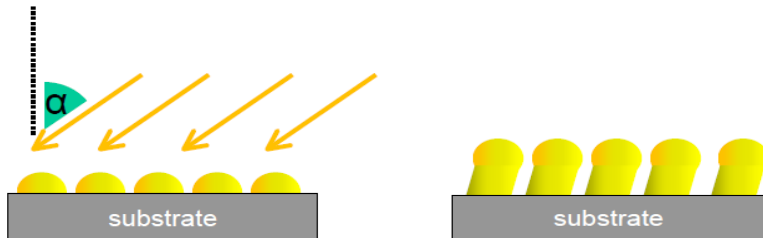
- The Raman effect is very weak; only 1 in a million of total scattering
- A trace amount of samples may be undetectable



# Fabrication of SERS by PVD at NECTEC

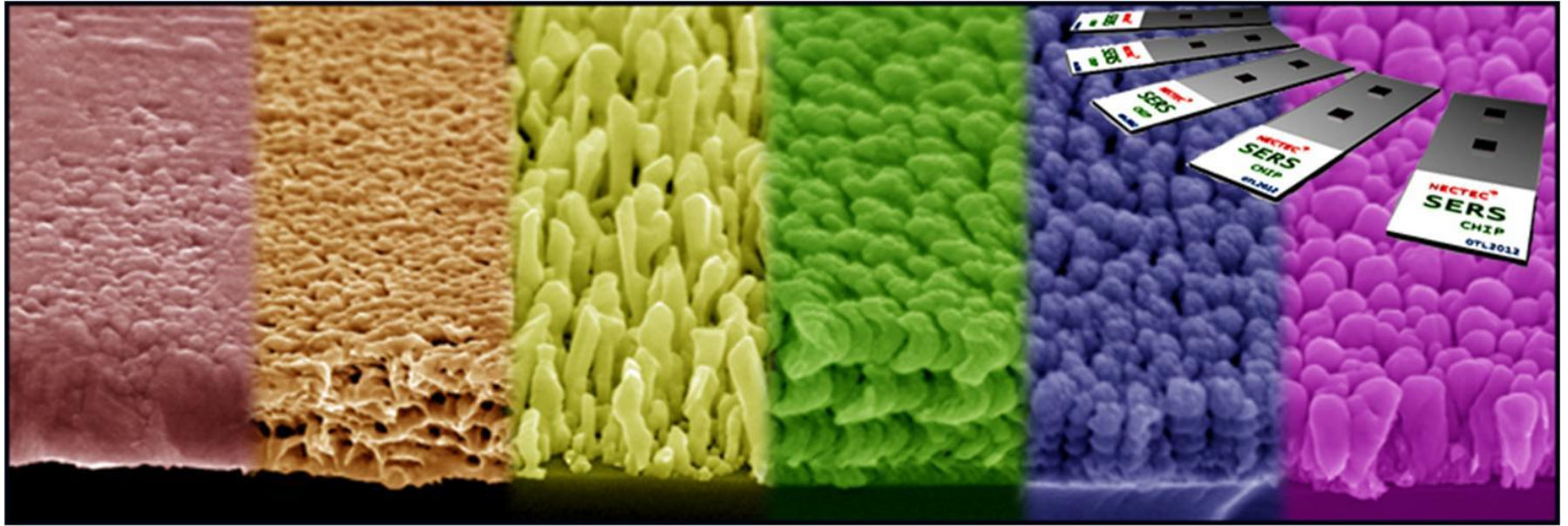


# Key Technique; Glancing-Angle Deposition (GLAD) and sputtering

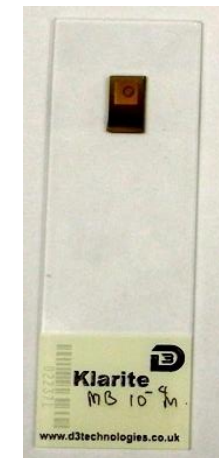
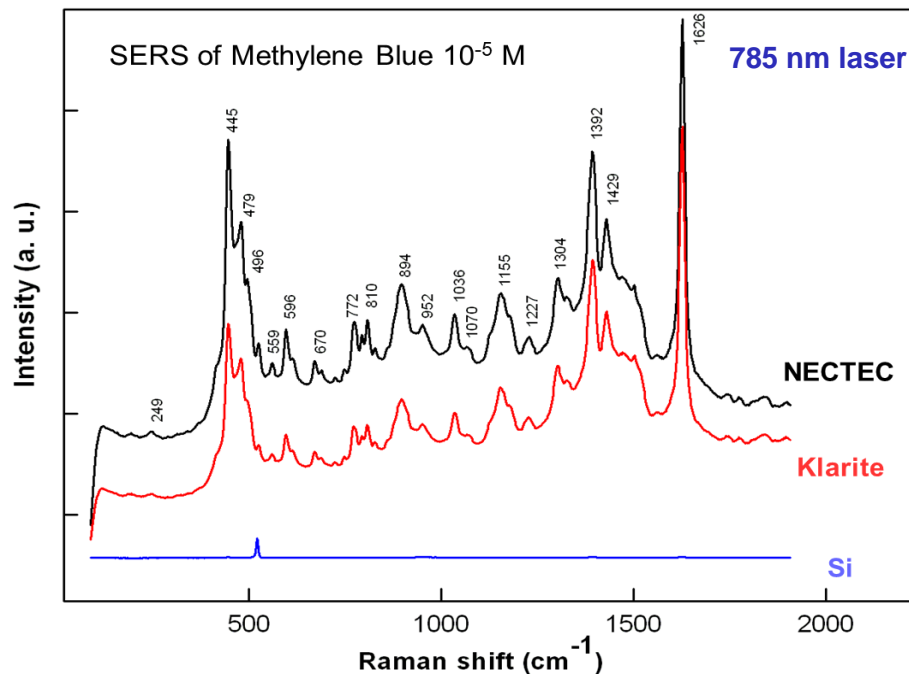
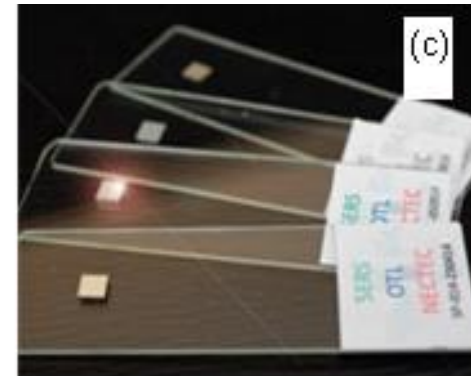
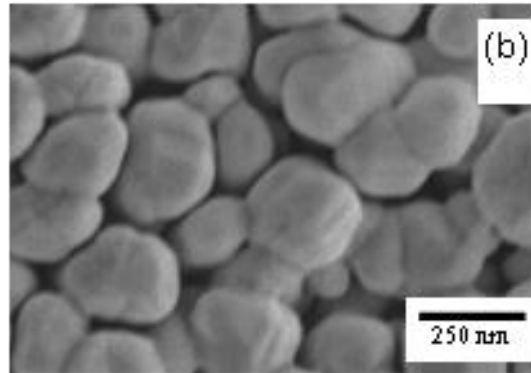
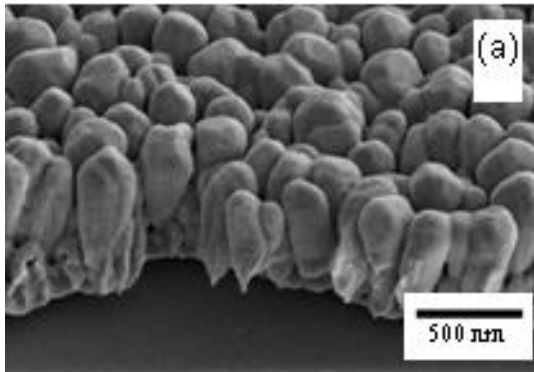




# Various Ag nanorod structures



# Performance benchmark test (2011)

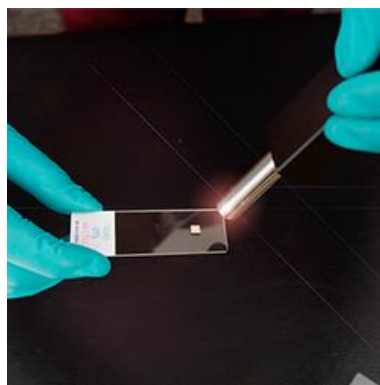
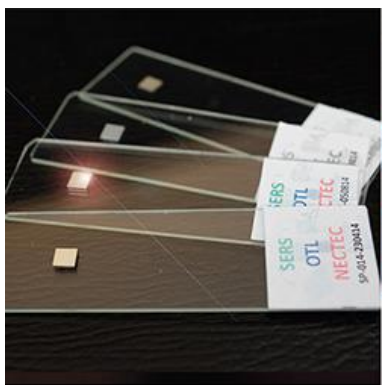


# OnSpec: NECTEC SERS Chips

(start from 2017)



Brand Name:	OnSpec
Type:	Film-based
Material:	Silver nanorods
Prep. Technique:	Physical vapor deposition – Sputtering technique – Glancing-angle deposition technique
Spec.:	Compatible with all Raman spectrometers Most compatible with 785nm laser
Features:	Used for trace detections of chemical molecules





# OnSpec series



**ONSPEC**  
NECTEC SERS Chips

**ONSPEC SERIES**  
NECTEC  
SERS Chips

Sensors for Trace  
Chemical Analyses

NSTDA NECTEC  
a member of NSTDA

Opto-Electrochemical Sensing Research Team (OEC)  
Spectroscopic and Sensing Devices Research Unit (SSDRU)  
National Electronics and Computer Technology Center (NECTEC)  
E-mail : business@nectec.or.th



NECTEC offers a product solution of SERS substrates, the "OnSpec" series, that can be utilized in a wide range of applications.

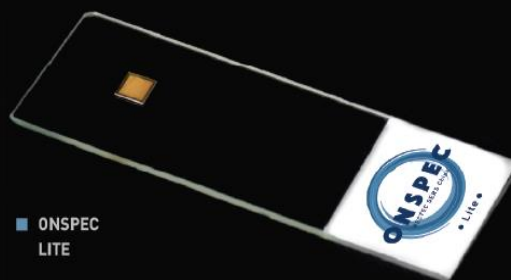
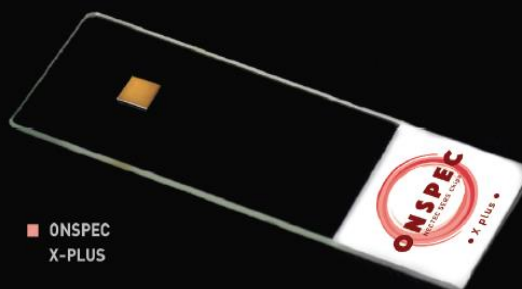
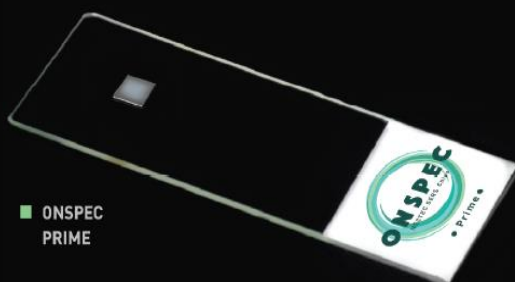
ONSPEC PRIME

ONSPEC X-PLUS

ONSPEC LITE

The OnSpec series can now be used for trace detections in food ingredients (pesticides, odors), forensic investigations (narcotic drugs, explosive substances, pen inks), and medical studies (biomolecules).

# OnSpec series



MODEL	ONSPEC-Prime	ONSPEC-X Plus	ONSPEC-Lite
<b>Material:</b>	Silver films	Gold nanoparticles	Gold nanoparticles
<b>System Compatibility:</b>	All Raman spectroscopes	All Raman spectroscopes	All Raman spectroscopes
<b>Laser Compatibility:</b>	532, 633, 785 nm	532, 633, 785 nm	532, 633, 785 nm
<b>Test Method:</b>	Drop-dry solution	Drop-dry solution	Drop-dry solution
<b>Features:</b>	Ultra-sensitive	Reusable up to 10 times * Reusable cycles are subject to test specimens	Most optimized for portable/handheld Raman systems
<b>Remark:</b>	Test solution may be applied within 30 minutes.	Require UV exposure for 15 minutes. * Reusable time is subject to test specimens	Surface is hydrophobic. Water-based solution may require larger droplets.

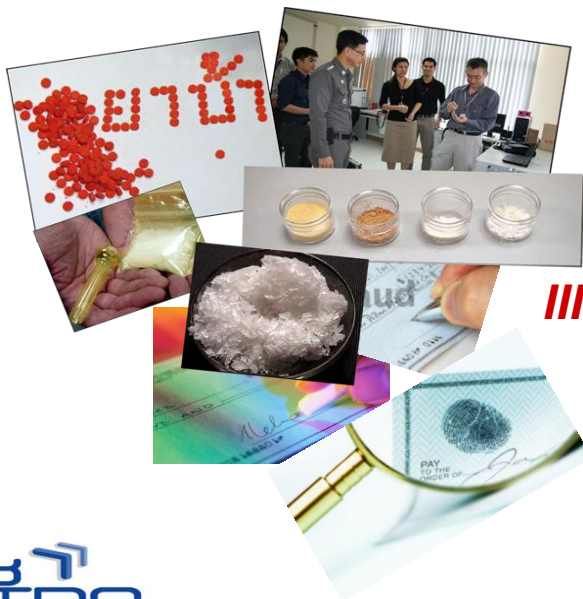
# Trace analysis applications



## ***I. Agricultural and food contaminations***



## ***II. Homeland securities***



## ***III. Forensics***



## ***IV. Biomedicals***



# Applications summary

## **I. Agricultural and food contaminations**

- Pesticides
- Water odor

## **II. Homeland securities**

- Investigating explosive substances

## ***III. Forensics***

- Inks on document discrimination
- Methamphetamine

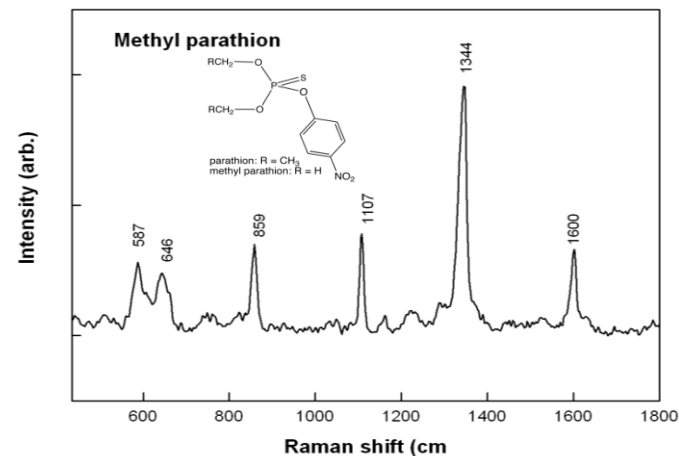
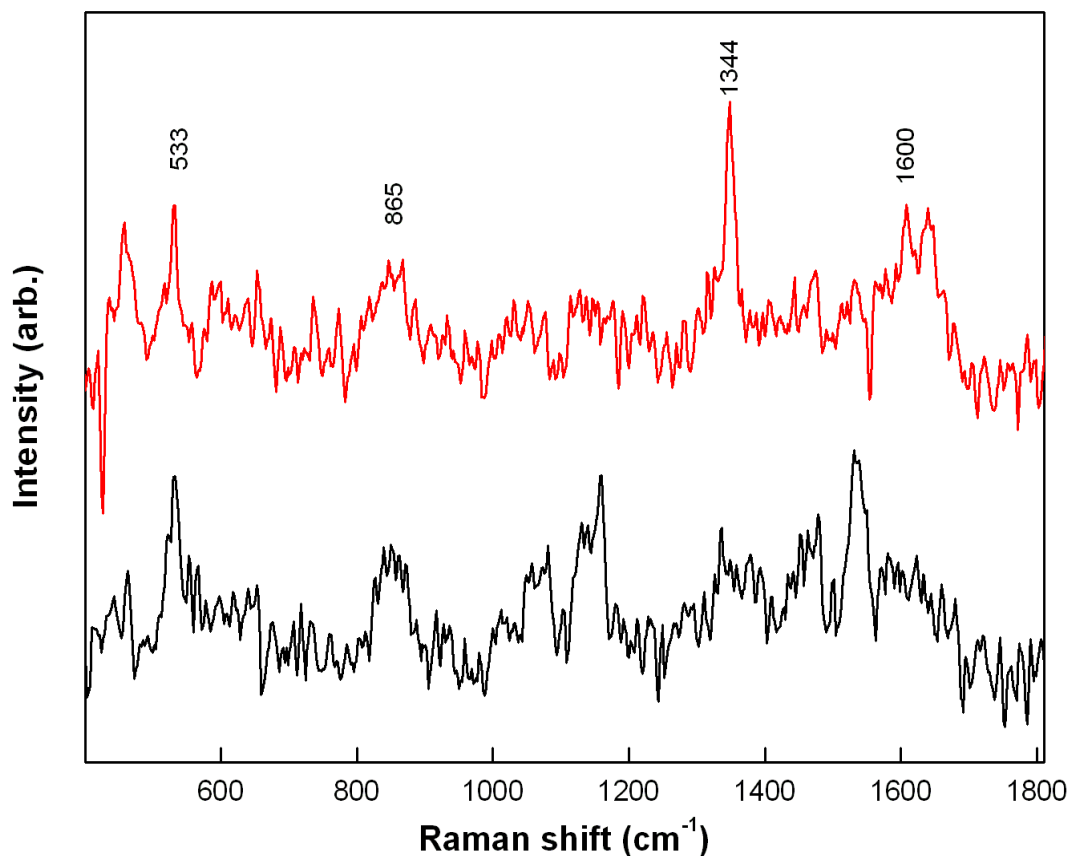
## ***IV. Biomedicals***

- Tuberculosis (TB)
- Dengue (DV) and other viruses



# Pesticides

## Demostration of trace detection in orange juice!



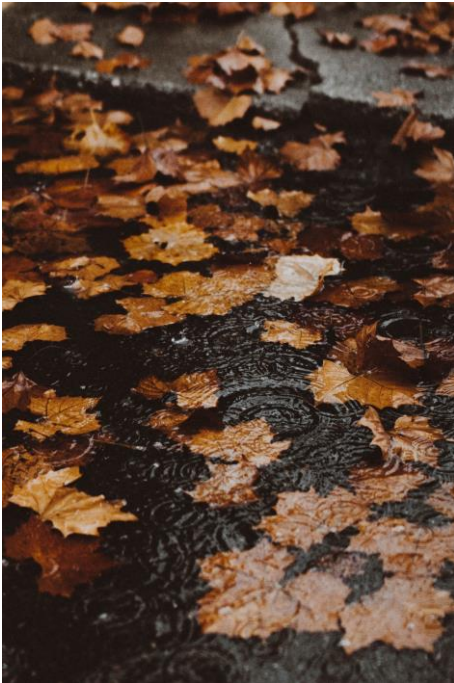
Orange juice exposed  
with Methyl parathion  
(3 ppm)



<https://unsplash.com/>

# Detection and quantification of water odor

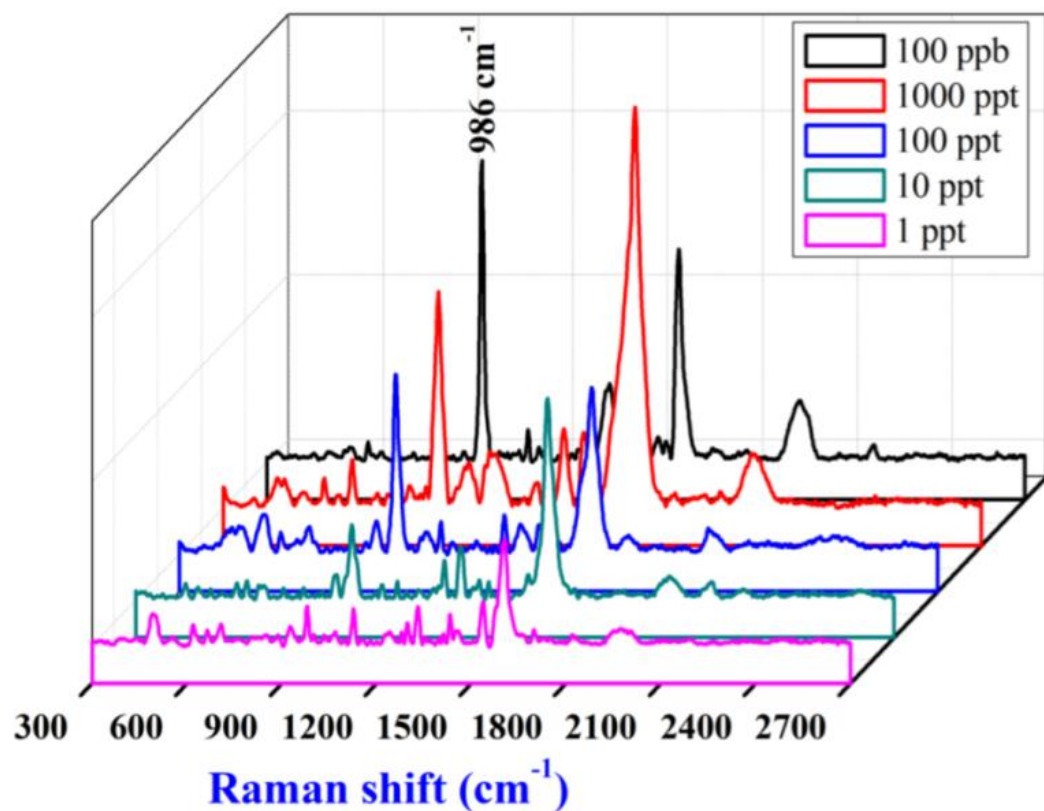
## 2-Methylisoborneol (2-MIB)



Muddy smell

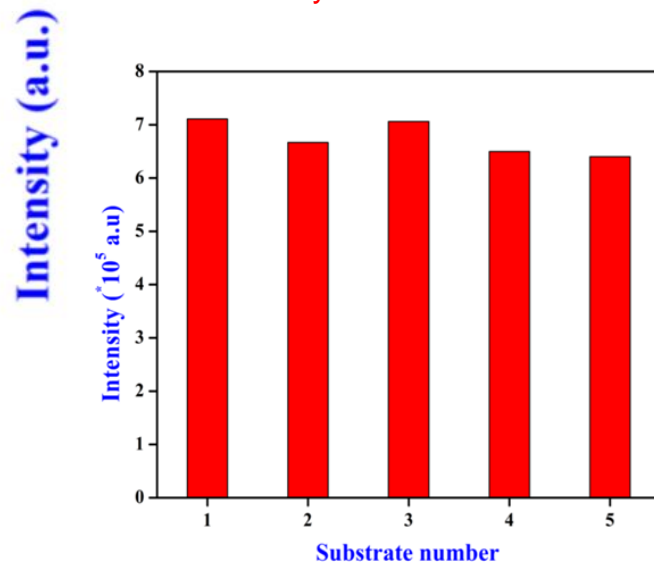


# Detection and quantification of water odor



SERS spectra of 1 ppm of 2-MIB with different laser powers of 785 nm excitation wavelength. There is no evidence of Raman line at  $986 \text{ cm}^{-1}$ .

High uniformity and reproducibility;  
<5% intensity variation between substrates.



Substrate-substrate SERS intensity variation at  $986 \text{ cm}^{-1}$  measured for 5 different SERS-chips. Each intensity value represents the average value of 10 different random positions.

# Trace explosive detections



ANFO



TNT



RDX



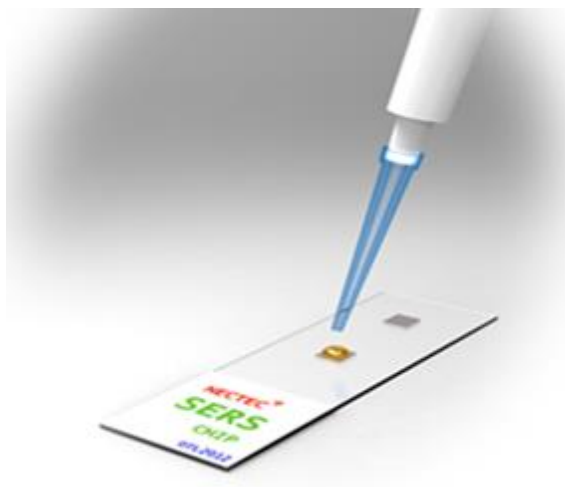
Tetryl



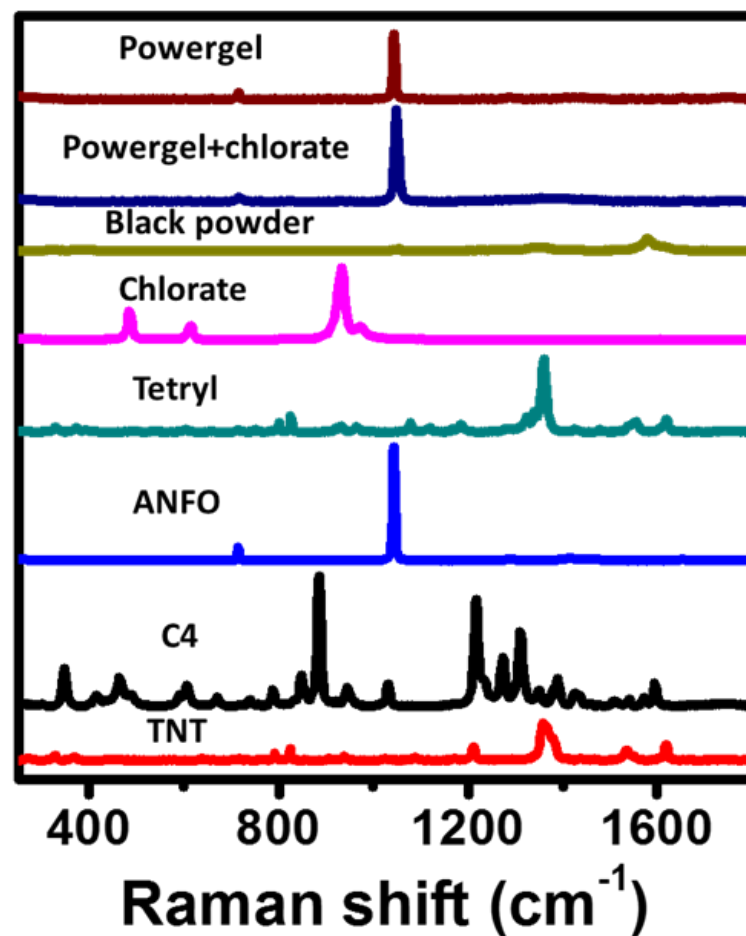
Black powder



PETN



Intensity (a.u.)







# Sensors for **TRACE CHEMICAL ANALYSES**

CONTACT



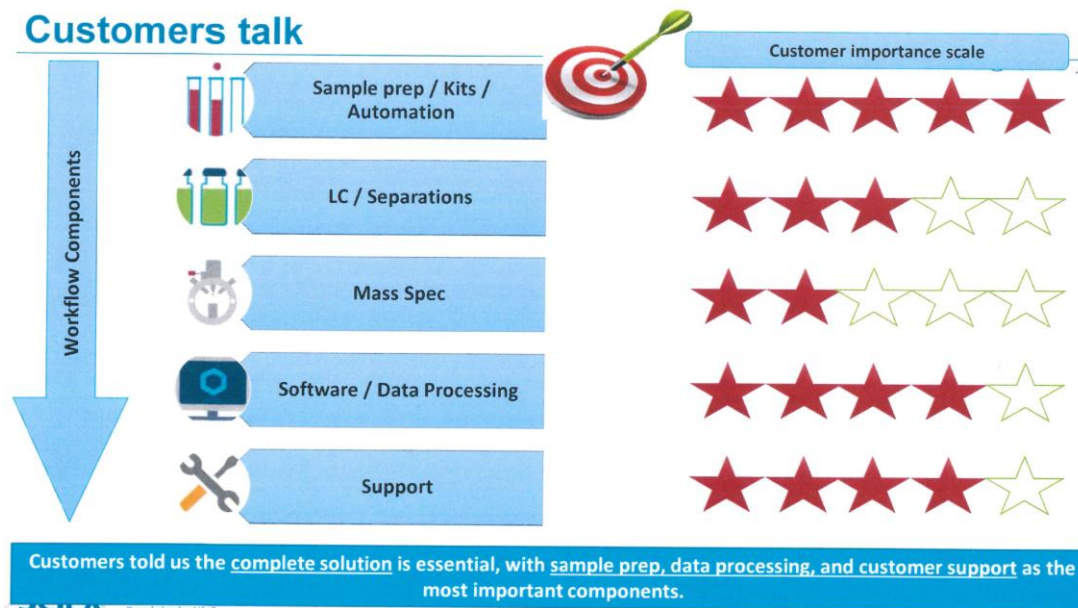
 Optical Thin-Film Technology Laboratory (OTL)  
 Spectroscopic and Sensing Devices Research Unit (SSDRU)  
 National Electronics and Computer Technology Center (NECTEC)  
 E-mail : [business@nectec.or.th](mailto:business@nectec.or.th)



# Challenges of implementing SERS technique

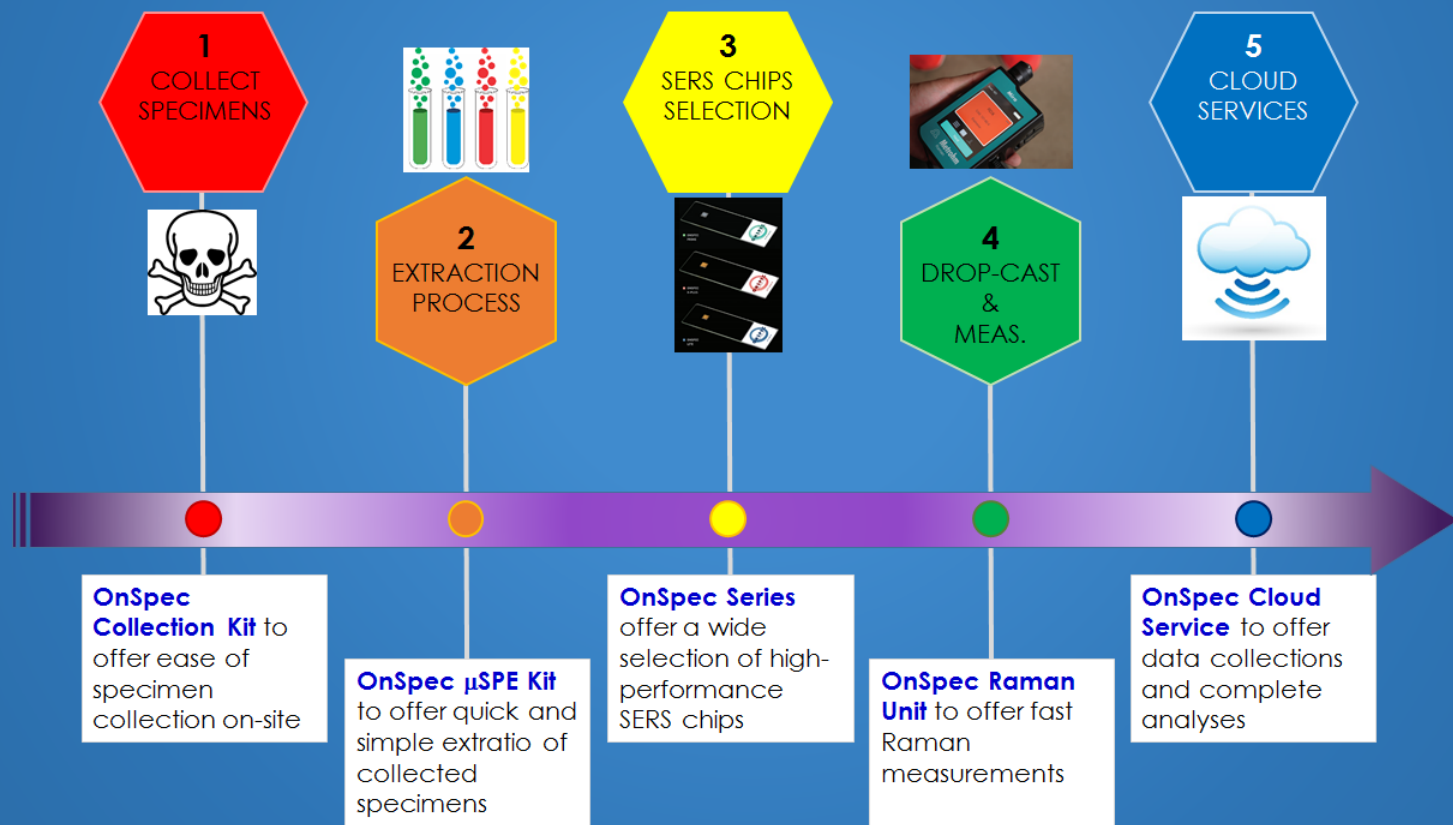
1. *Performance of most commercial substrates are just mediocre for target substance*
2. *Lack of ready-to-use protocol for real-world samples*
3. *SERS database and online interpretation are not available (Data analysis is complicate for end user, IOT will help accessibility of the technique to trace analytical business)*

**#2 is similar to mass spectroscopy (MS) business pain!**



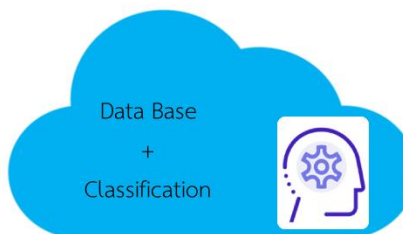
# ONSPEC SERS ECOSYSTEM

## OEC/SSDRU NECTEC

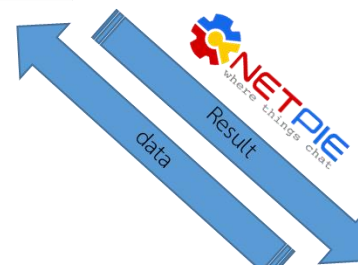
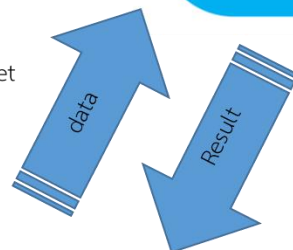


# Proposed OnSpec solution ecosystem

Developer



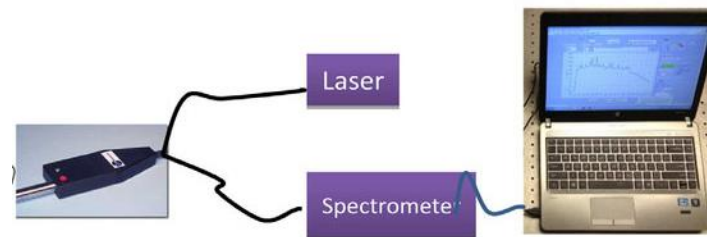
Web socket  
+  
NETPIE



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NECTEC Raman system prototype