



ONSPEC SERIES

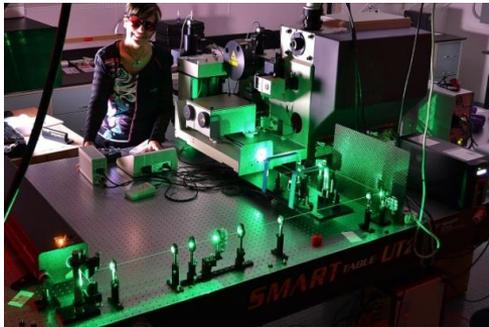
NECTEC SERS substrates

Noppadon Nuntawong, Ph.D.

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

Raman spectroscopy

Classical system



Modern Raman imaging system



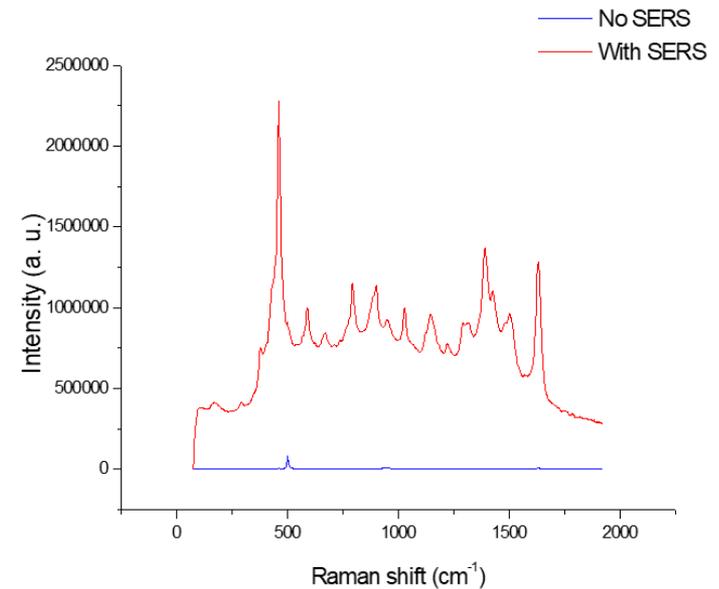
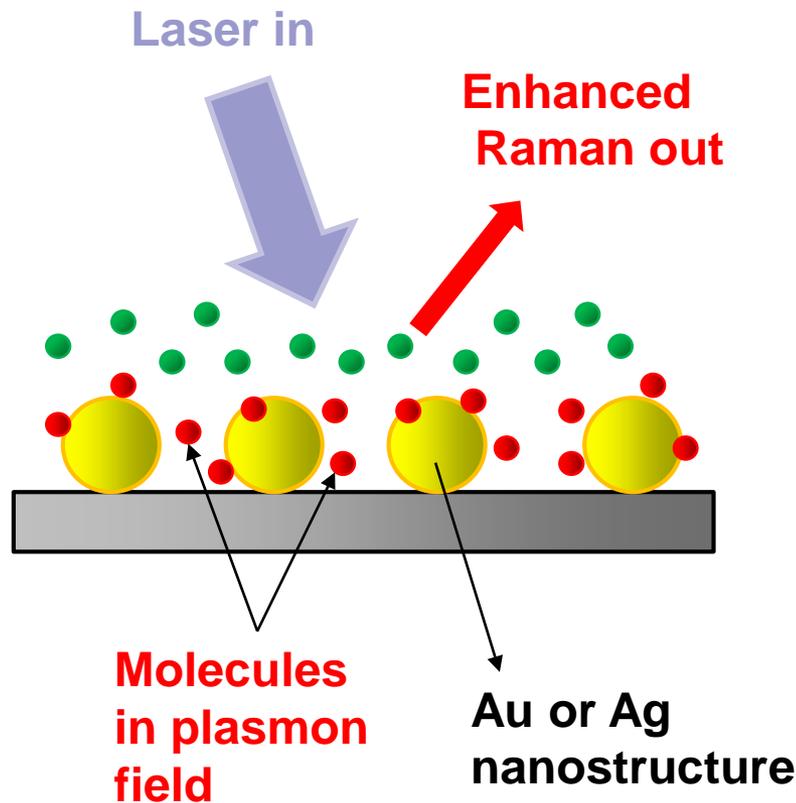
Handheld Raman



Surface-enhanced Raman scattering

Improve sensitivity of Raman Spectroscopy!

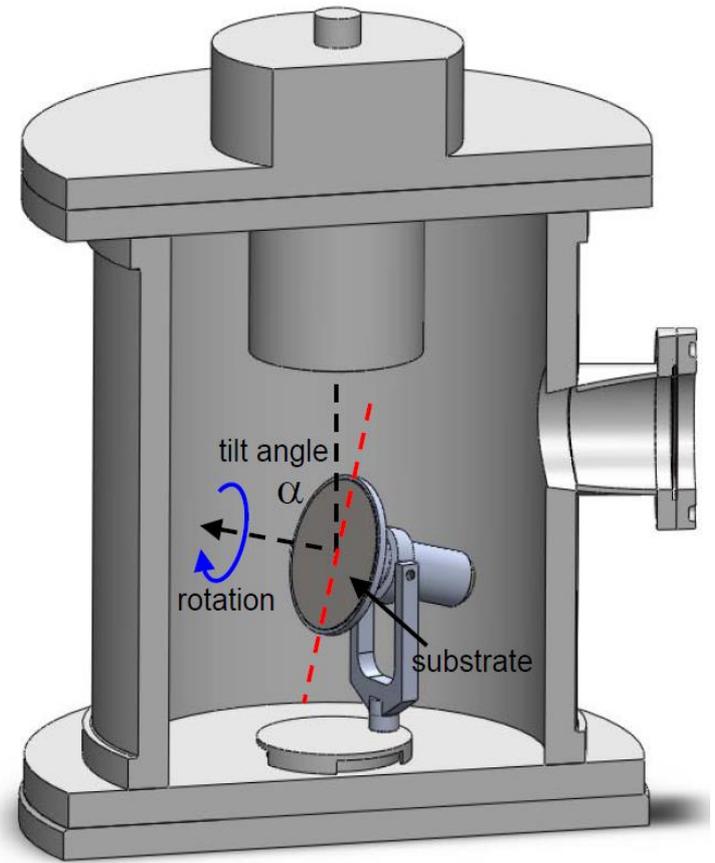
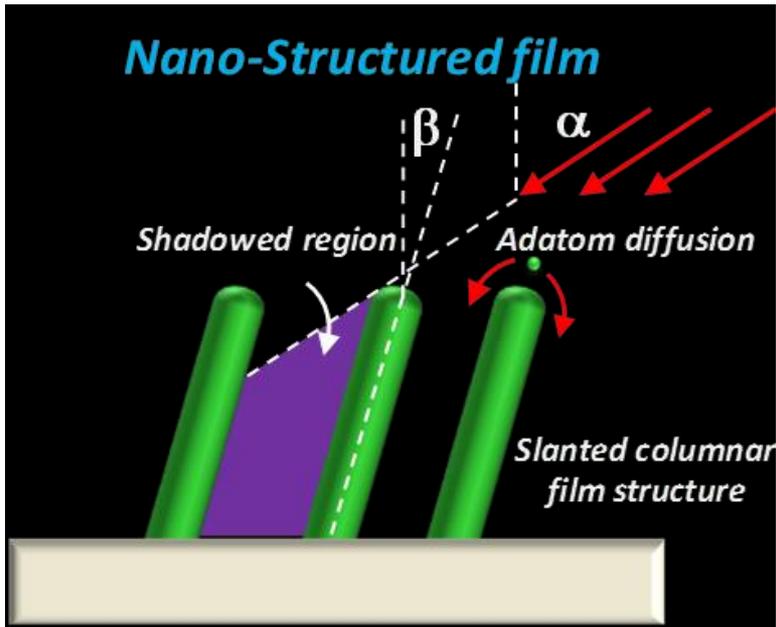
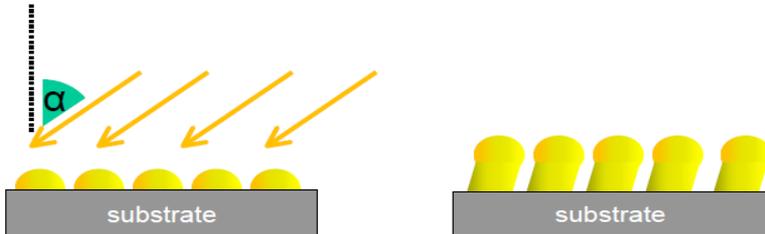
- The Raman effect is very weak; only 1 in a million of total scattering
- A trace amount of samples may be undetectable



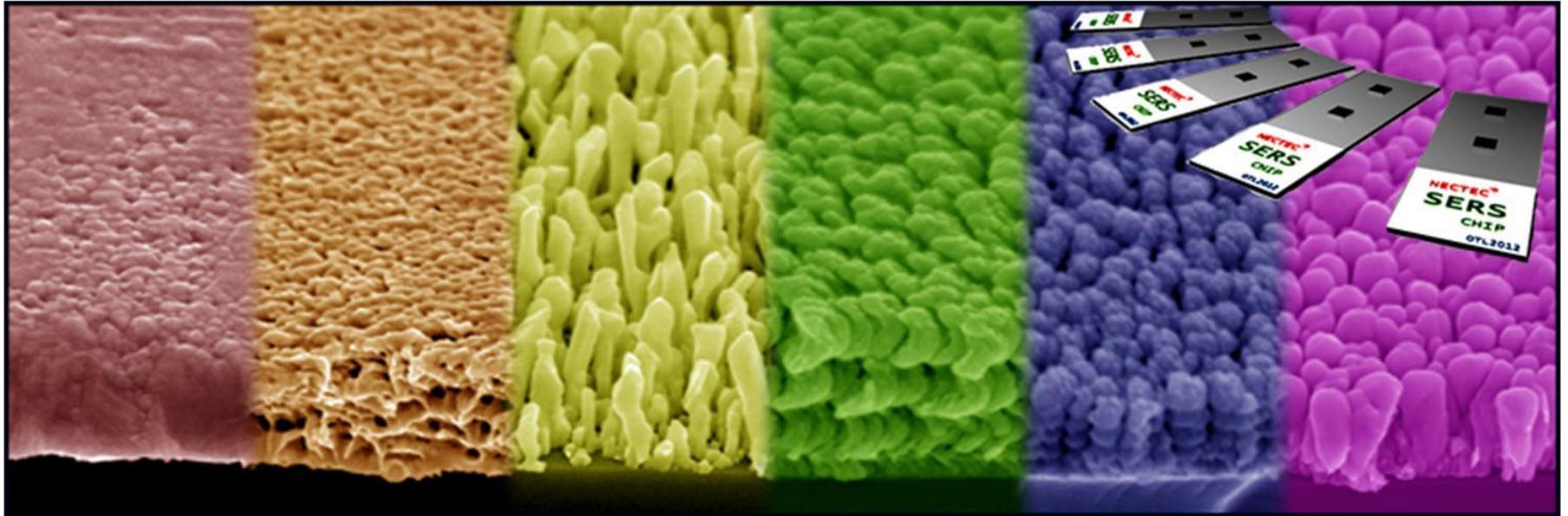
Fabrication of SERS by PVD at NECTEC



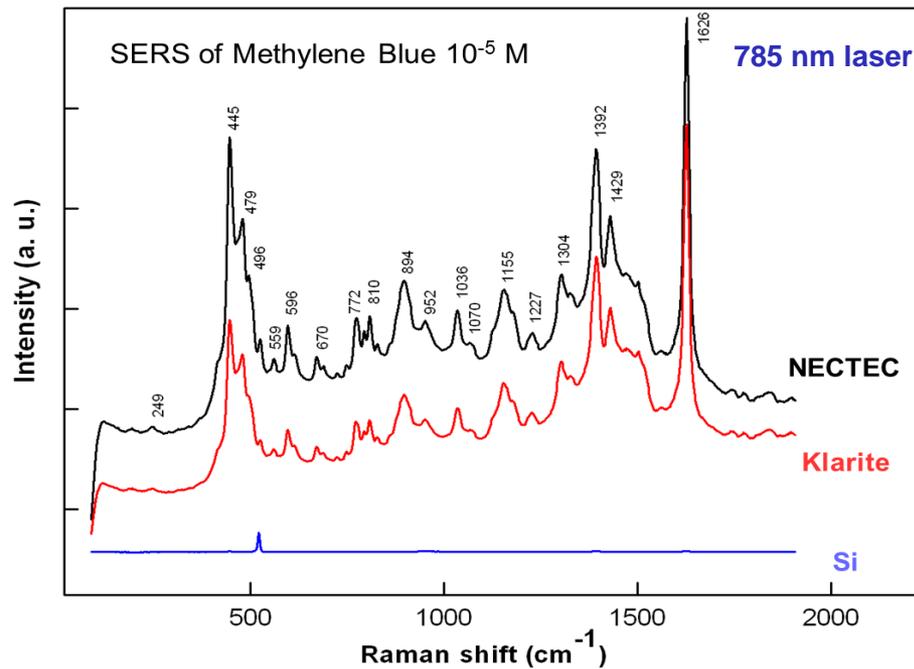
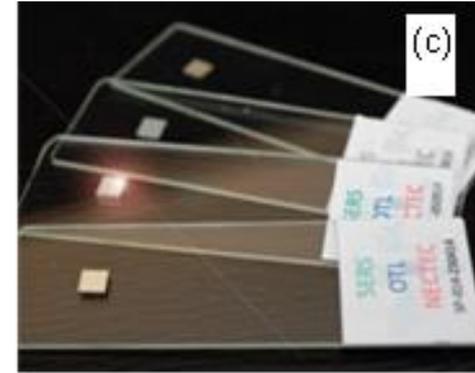
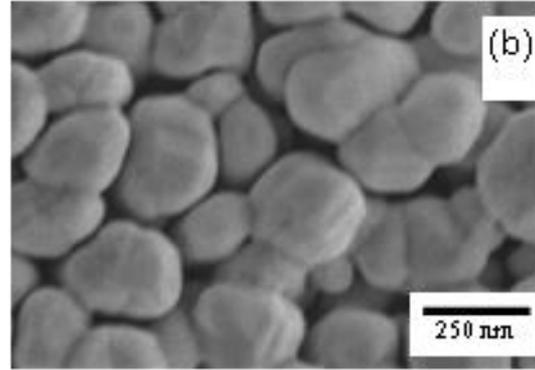
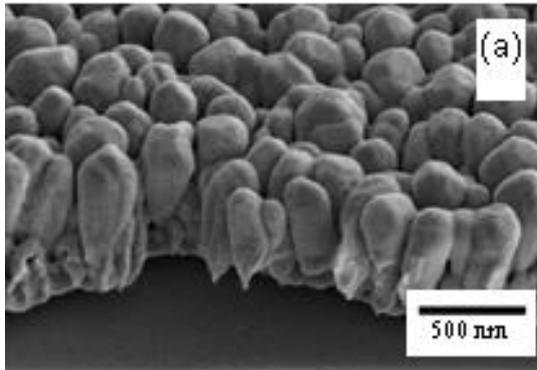
Key Technique; Glancing-Angle Deposition (GLAD) and sputtering



Various Ag nanorod structures



Performance benchmark test (2011)

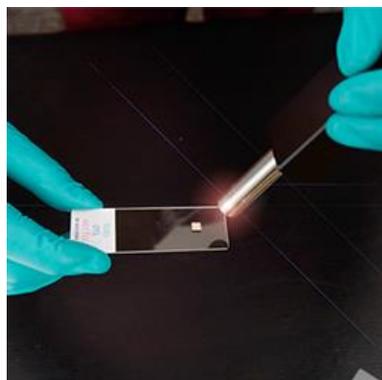
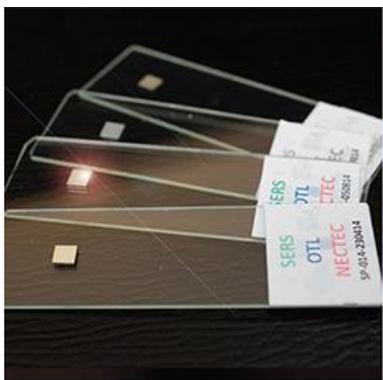


OnSpec: NECTEC SERS Chips

(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



ONSTDA NECTEC
A MEMBER OF NSTDA

ONSPEC
NECTEC SERS Chips

ONSPEC SERIES
NECTEC
SERS Chips

Sensors for Trace
Chemical Analyses

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



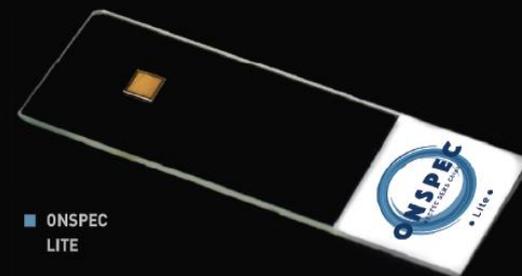
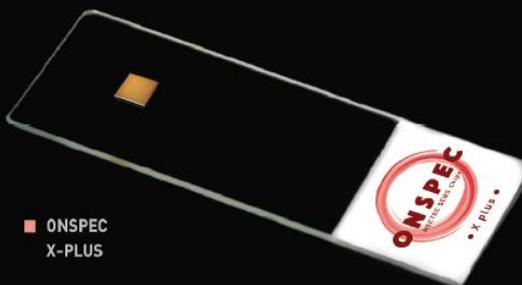
NECTEC offers a product solution of SERS substrates, the "OnSpec" series, that can be utilized in a wide range of applications.

- 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
Material:	Silver films	Gold nanoparticles	Gold nanoparticles
System Compatibility:	All Raman spectroscopes	All Raman spectroscopes	All Raman spectroscopes
Laser Compatibility:	532, 633, 785 nm	532, 633, 785 nm	532, 633, 785 nm
Test Method:	Drop-dry solution	Drop-dry solution	Drop-dry solution
Features:	Ultra-sensitive	Reusable up to 10 times * Reusable cycles are subject to test specimens	Most optimized for portable/handheld Raman systems
Remark:	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.

Applications summary

I. Agricultural and food contaminations

- Pesticides
- Water odor

II. Homeland securities

- Investigating explosive substances

III. Forensics

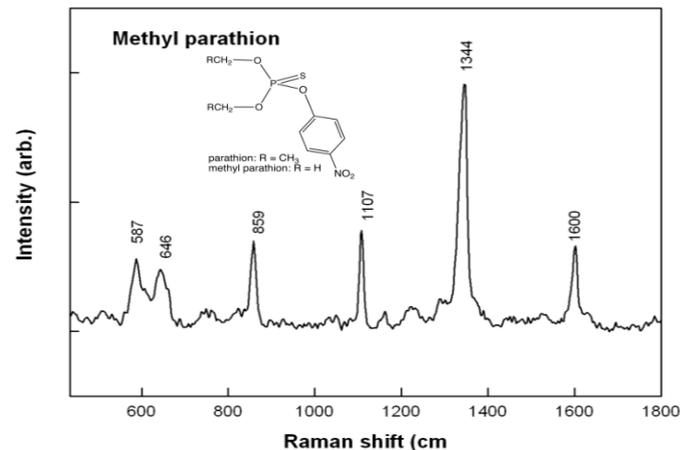
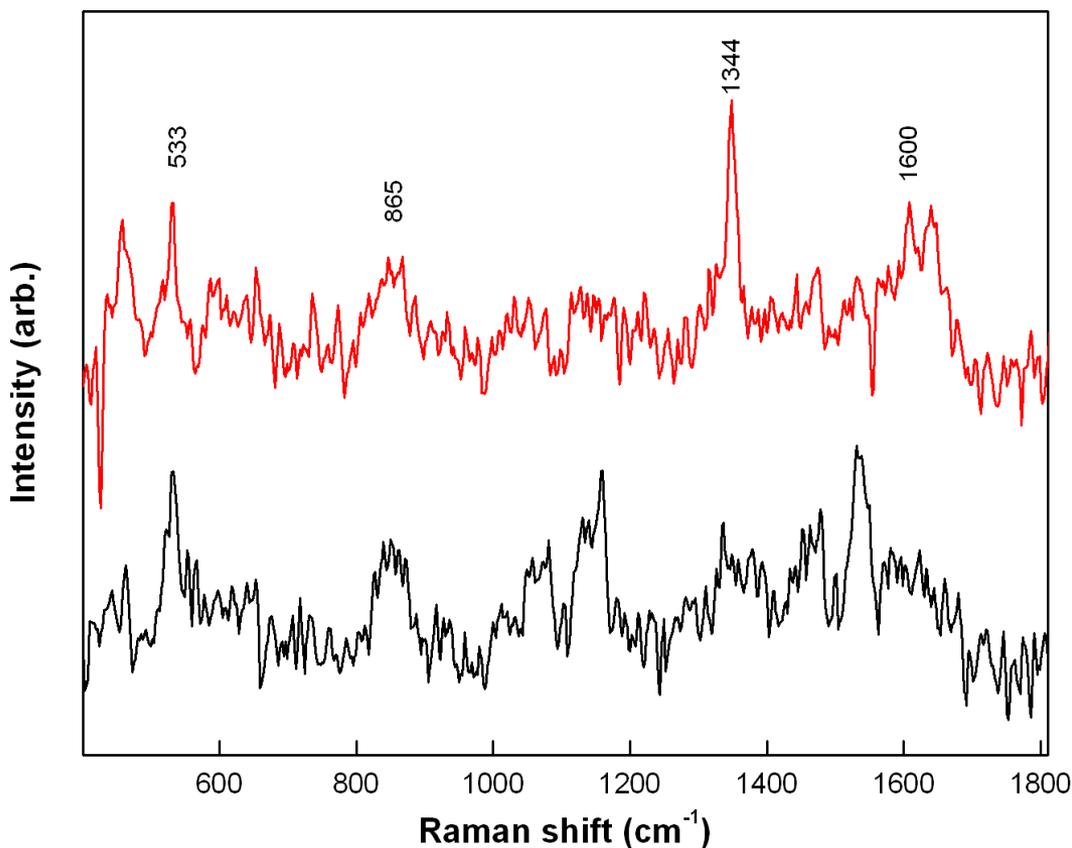
- Inks on document discrimination
- Methamphetamine

IV. Biomedicals

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

Pesticides

Demostration of trace detection in orange juice!



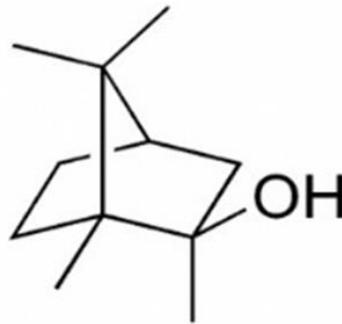
Orange juice exposed
with Methyl parathion
(3 ppm)



<https://unsplash.com/>

Detection and quantification of water odor

2-Methylisoborneol (2-MIB)

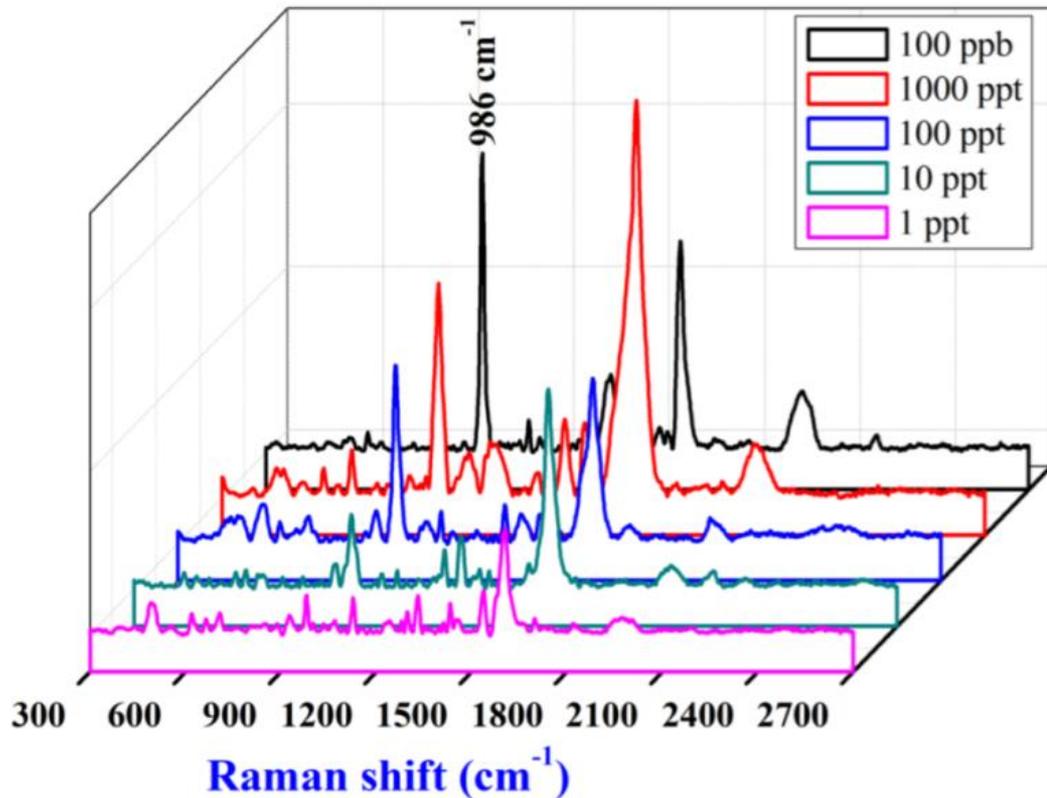


MIB

Muddy smell

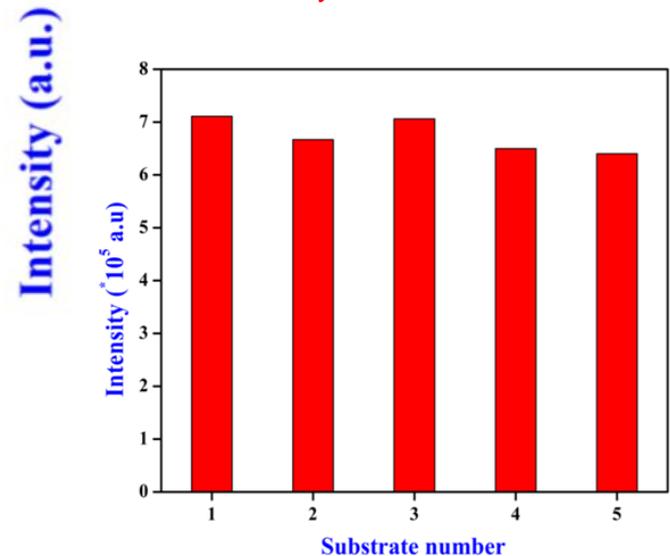


Detection and quantification of water odor



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 cm⁻¹.

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



Substrate-substrate SERS intensity variation at 986 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



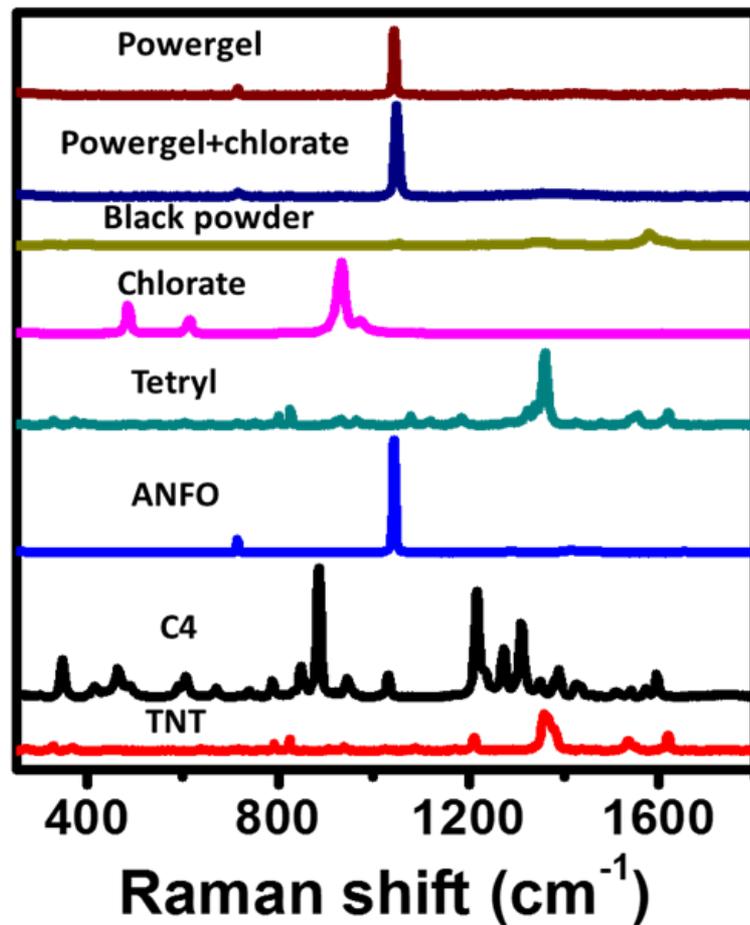
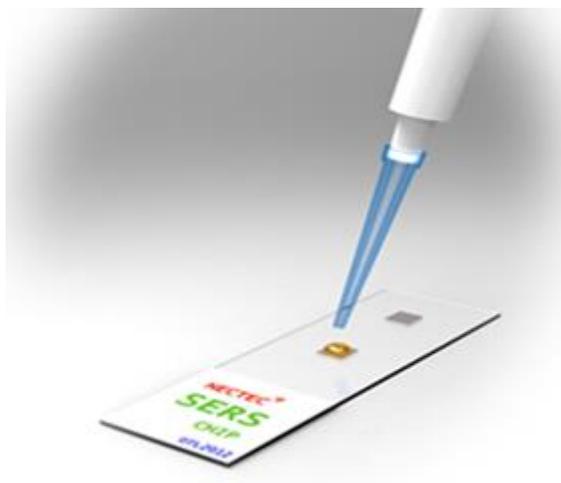
Tetryl



Black powder



PETN





Sensors for **TRACE CHEMICAL ANALYSES**

CONTACT



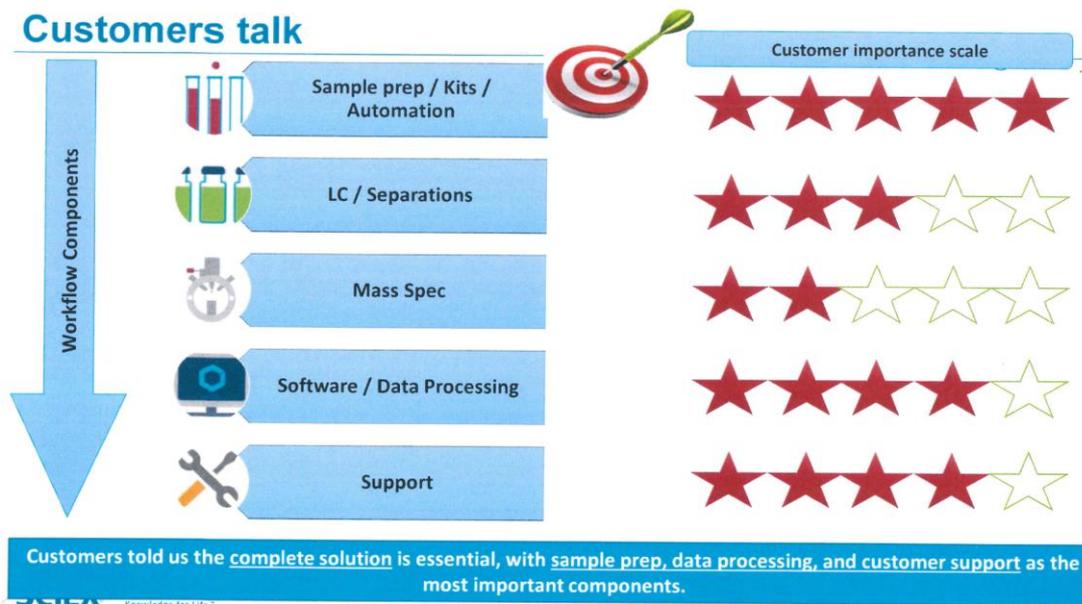
 Optical Thin-Film Technology Laboratory (OTL)
Spectroscopic and Sensing Devices Research Unit (SSDRU)
National Electronics and Computer Technology Center (NECTEC)
E-mail : business@nectec.or.th



Challenges of implementing SERS technique

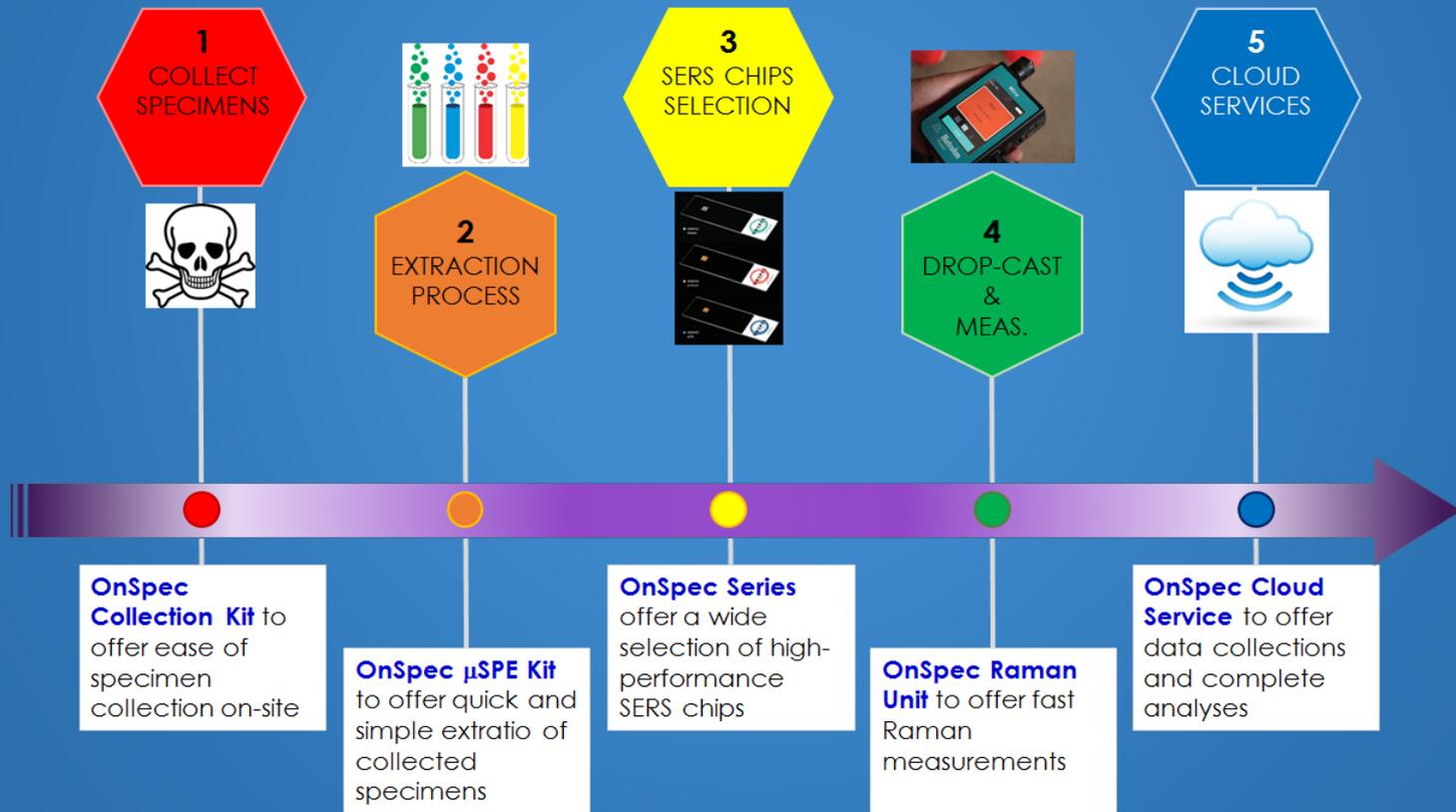
1. *Performance of most commercial substrates are just mediocre for target substance*
2. *Lack of ready-to-use protocol for real-world samples*
3. *SERS database and online interpretation are not available (Data analysis is complicate for end user, IOT will help accessibility of the technique to trace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

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

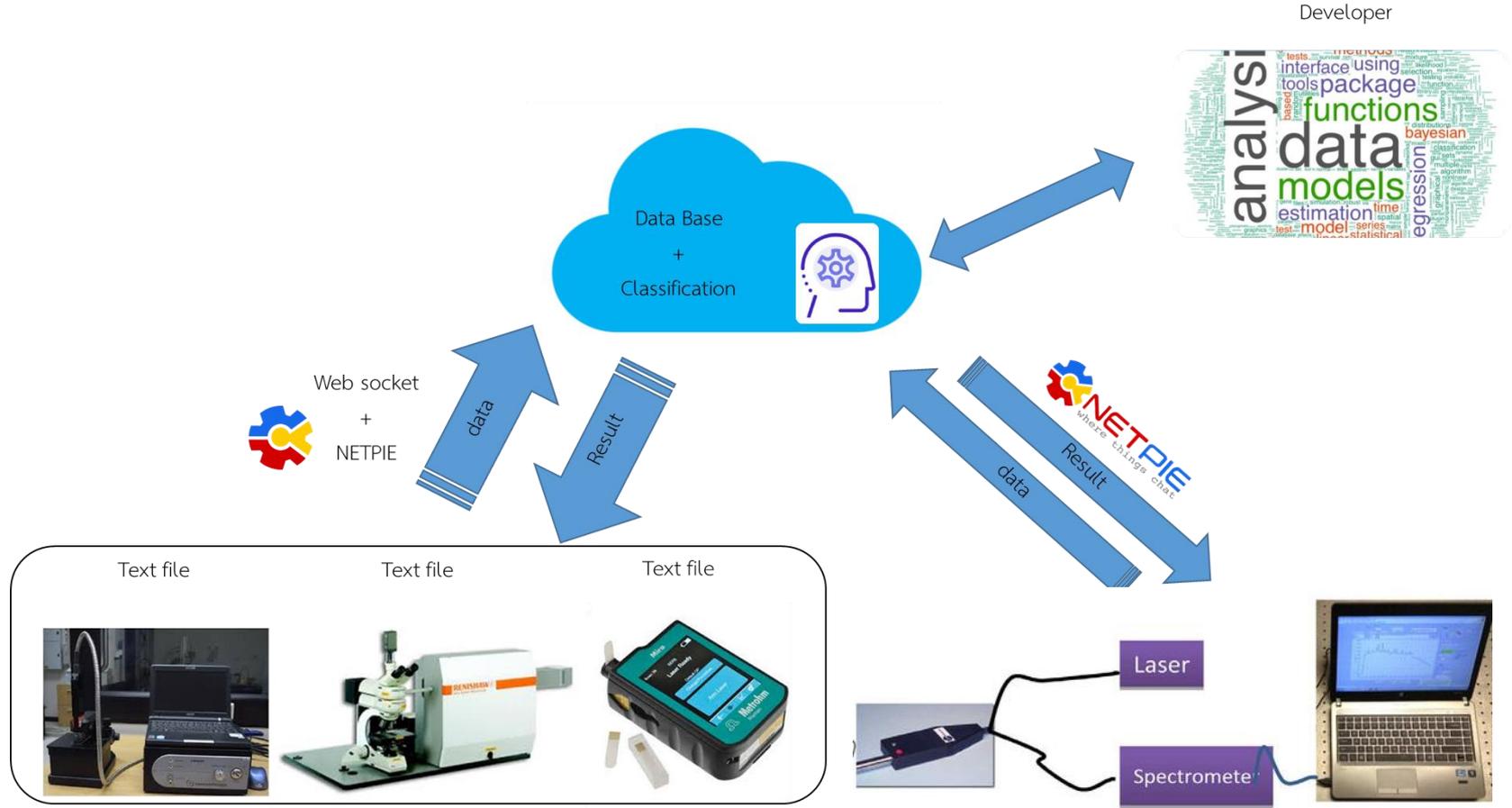


ONSPEC SERS ECOSYSTEM

OEC/SSDRU NECTEC



Proposed OnSpec solution ecosystem



NECTEC Raman system prototype