Technical Service Platform for 266 nm Laser Spectroscopies

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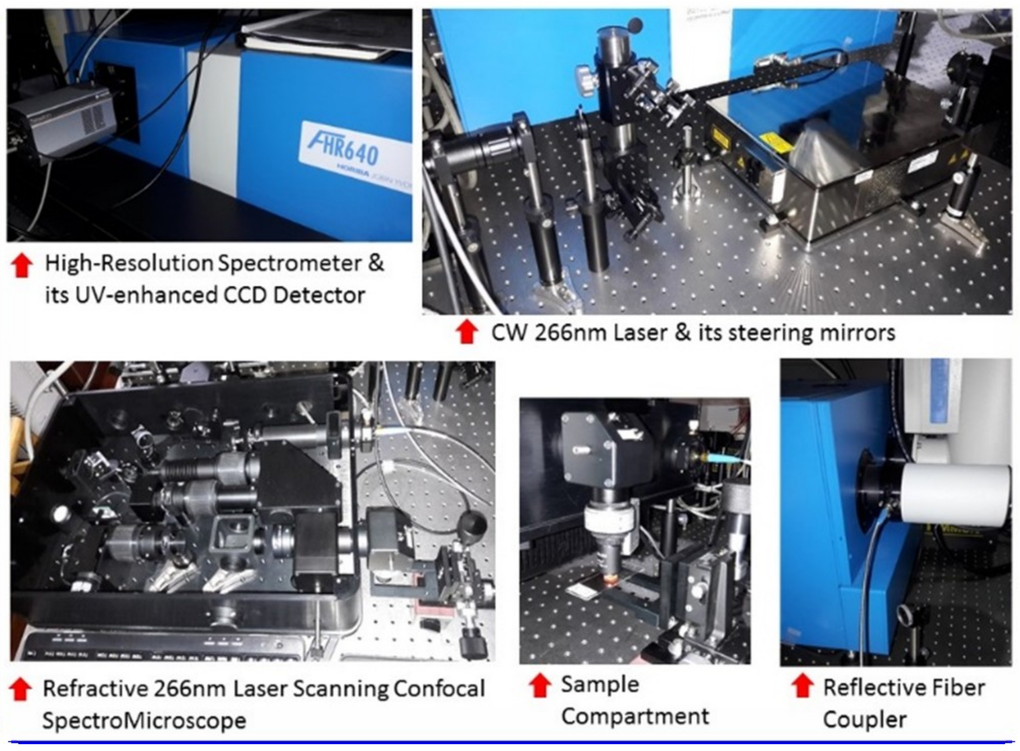
Introduction

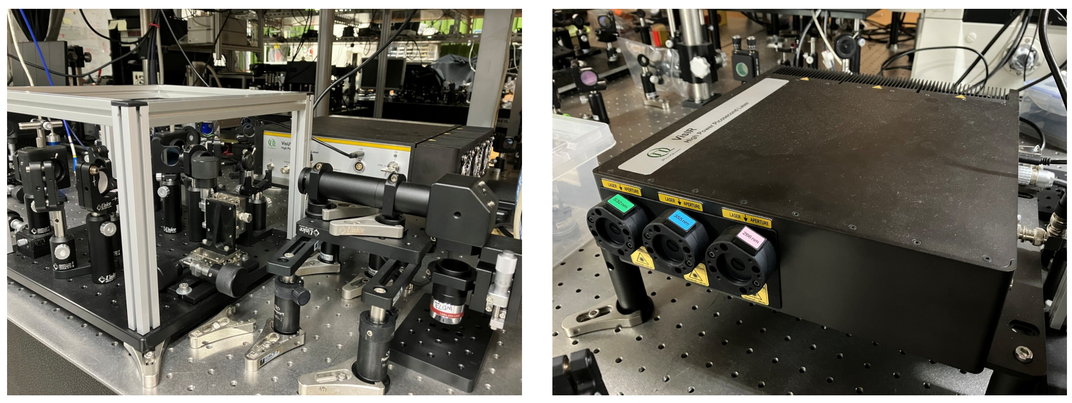
Our laboratory have developed and built a laser spectroscopy measurement platform using a CW 266 nm (4.66 eV) and a picosecond pulsed 266 nm laser as the excitation sources. This platform can offer technical services for microscopic photoluminescence (PL) and Raman spectroscopy, and time-resolved photoluminescence (TRPL) spectroscopy with sub-nanosecond time resolution. The platform is particularly suitable for the research and development of wide bandgap (i.e. E_g > 3.0 eV) semiconductor materials (eg. $Al_xGa_{1-x}N$, $Al_xIn_{1-x}N$, Ga_2O_3, ZnO, BN, etc.) and offers excellent detection sensitivity in the deep ultraviolet to visible spectral range.

266 nm Micro PL / Raman System



Specifications:
Laser Source: 266 nm CW laser
Laser Power: > 100 mW
Detection Range: 268 – 600 nm
Detectable Raman Shift: >300 cm-1
Spectrometer: Horiba FHR640 (Raman), MR-Spec (PL)

266 nm TRPL System

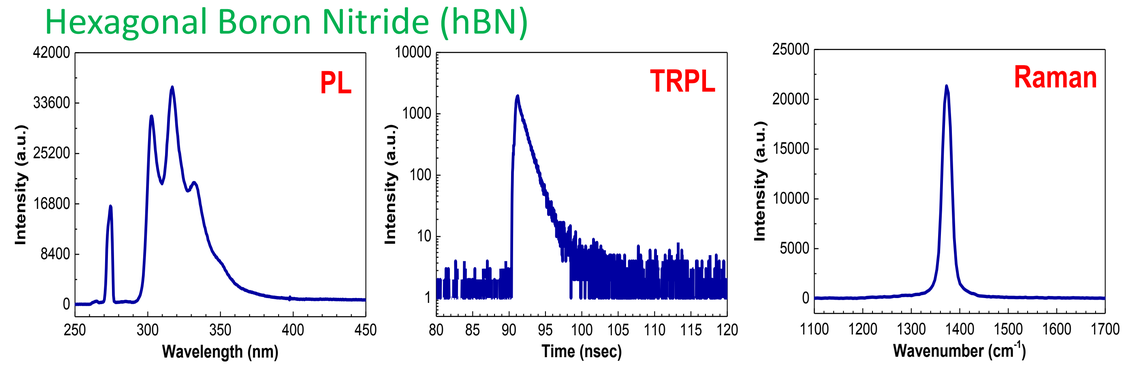


Specifications:
Laser Source : 266 nm Pulsed laser
Laser Power: < 2mW
Temporal Resolution: 25 psec
Detection Range: < 32 μs
Pulse Frequency: 40MHz – 31.25kHz
Instrument Response Function: ~ 150 psec
Detection Range : 268 ~ 600 nm
Spectrometer: MR-Spec / MR- mono
Detector: Andor iDus CCD & PMT

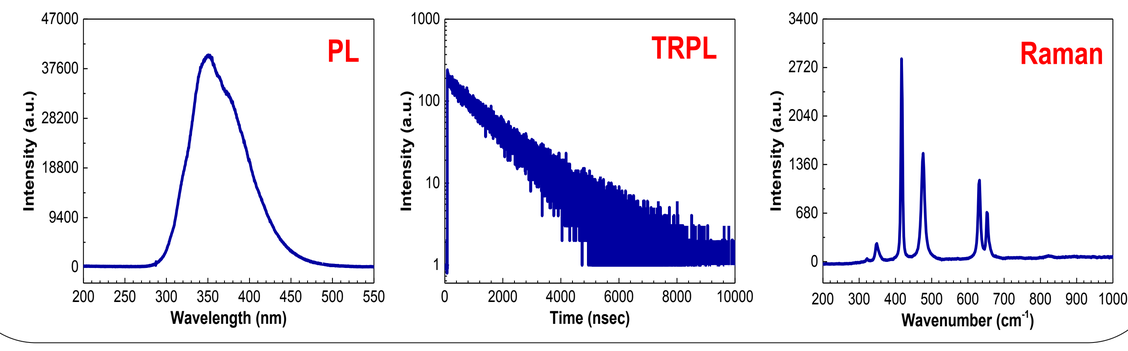
266 nm PL, TRPL, Raman

Sample 266 nm PL, TRPL, and Raman spectra from hexagonal boron nitride and gallium oxide

Hexagonal Boron Nitride (hBN)

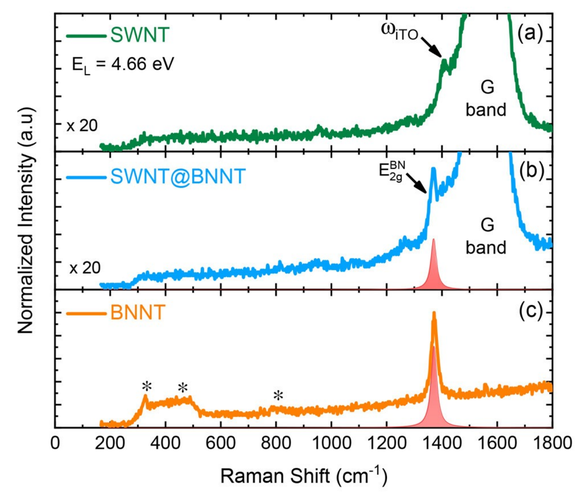


Gallium Oxide (Ga_2O_3)



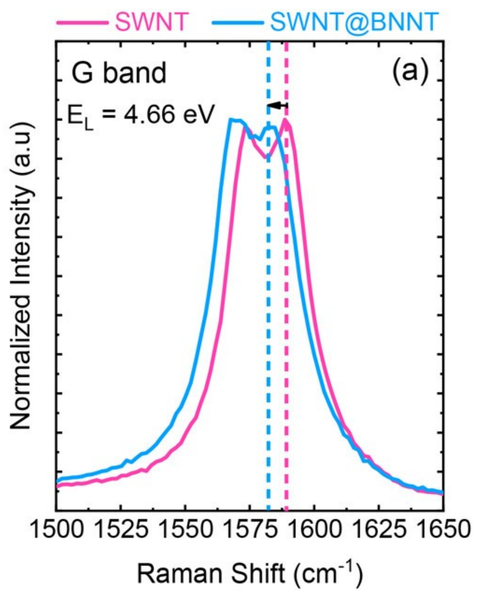
266 nm Raman of Carbon Nanotubes Inside Boron Nitride Nanotubes

266 nm Raman spectroscopy was used in conjunction with other laser excitation wavelength to explore phonon mode associated with the single walled carbon nanotubes inside boron nitride nanotubes (SWNT@BNNT).



266nm Raman spectra of
SWNT: Single walled carbon nanotube
SWNT@BNNT: SWNT inside BNNT
BNNT: Boron nitride nanotube
The E_{2g} mode of hBN at ~1370 cm^{-1} is visible in the spectra of BNNT and SWNT@BNNT.

The graphene G band of the SWNT@BNNT is red shifted by 3.8 cm^{-1} with respect to that of SWNT, due to the interlayer interaction between the layers of SWNT and BNNT.
The splitting of the G band into G^+ and G^- is due to the curvature effect of the nanotubes



Reference: Gulo, D.P.; Hung, N.T.; Chen, W.-L.; Wang, S.; Liu, M.; Kauppinen, E.I.; Maruyama, S.; Chang, Y.-M.; Saito, R.; Liu, H.-L.; Interacting Phonons between Layers in Raman Spectra of Carbon Nanotubes inside Boron Nitride Nanotubes *J. Phys. Chem. Lett.* **2023**, 14, 45, 10263–10270

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