

# Stimulated Raman Loss Spectroscopy : Collinear vs Non-collinear beam geometries

Sohee Lim<sup>1,2</sup>, Bonghwan Chon<sup>1,2</sup>, Hanju Rhee<sup>\*,3</sup> and Minhaeng Cho<sup>\*,1,2</sup>

<sup>1</sup>Center for Molecular Spectroscopy and Dynamics, Institute for Basic Science (IBS)

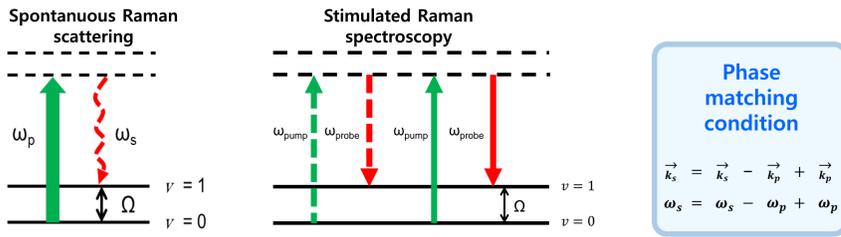
<sup>2</sup>Department of Chemistry, Korea University

<sup>3</sup>Space-Time Resolved Molecular Imaging Research Group, Korea Basic Science Institute (KBSI)

\*hjrhee@kbsi.re.kr, \*mcho@korea.ac.kr



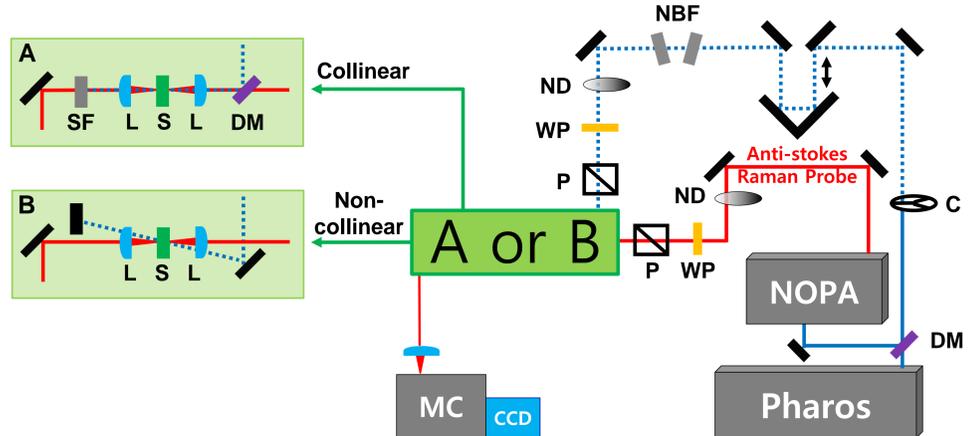
## Vibrational spectroscopy by Raman scattering process



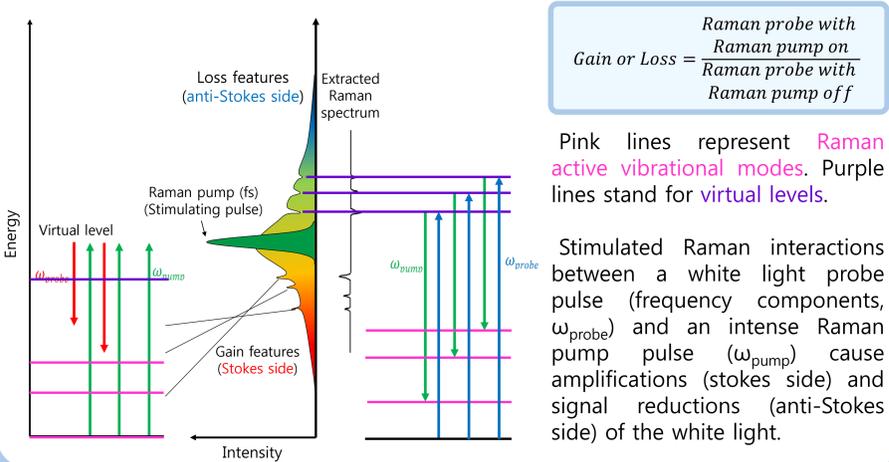
✓ In the spontaneous Raman spectroscopy, a coherent pump beam at  $\omega_p$  is incident on a sample, and Stokes  $\omega_s$  or anti-Stokes  $\omega_{AS}$  photons are generated.

✓ The stimulated Raman scattering (SRS) is a four-wave interaction. The Stimulated Raman Scattering (SRS) represents one of the third-order nonlinear optical processes.

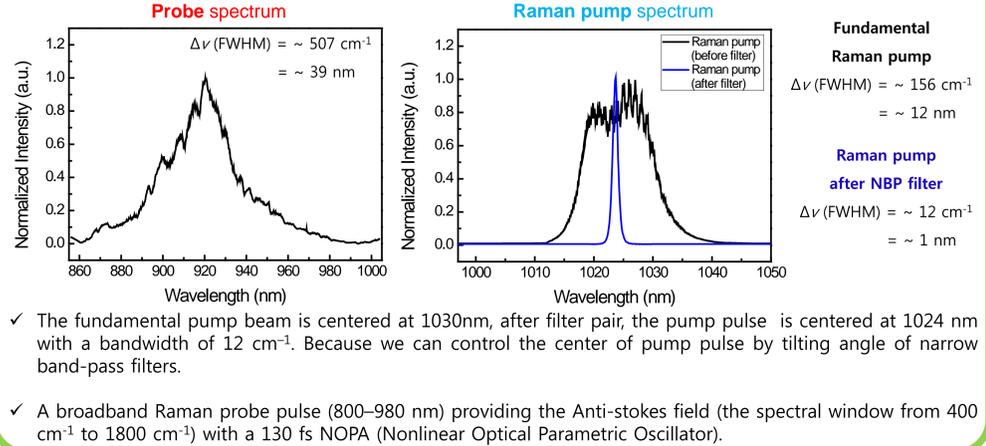
## Layout of the stimulated Raman spectrum measurement system



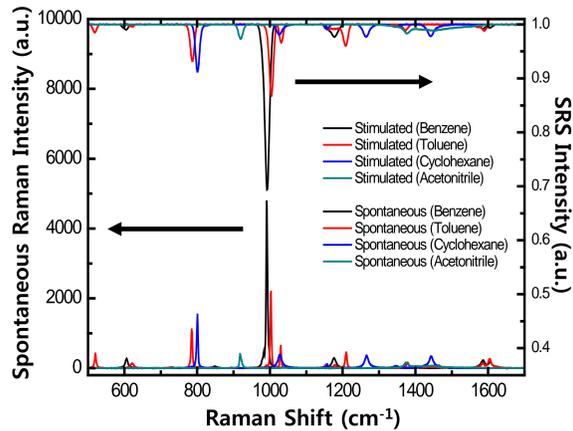
## Stimulated Raman Scattering (SRS) energy diagram



## Raman pump and Raman probe spectra



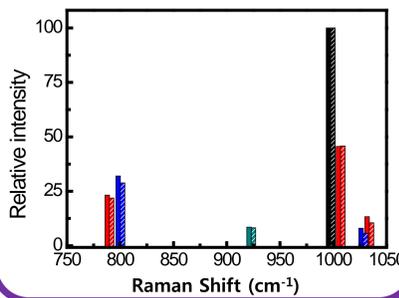
## Spontaneous and Stimulated Raman spectra



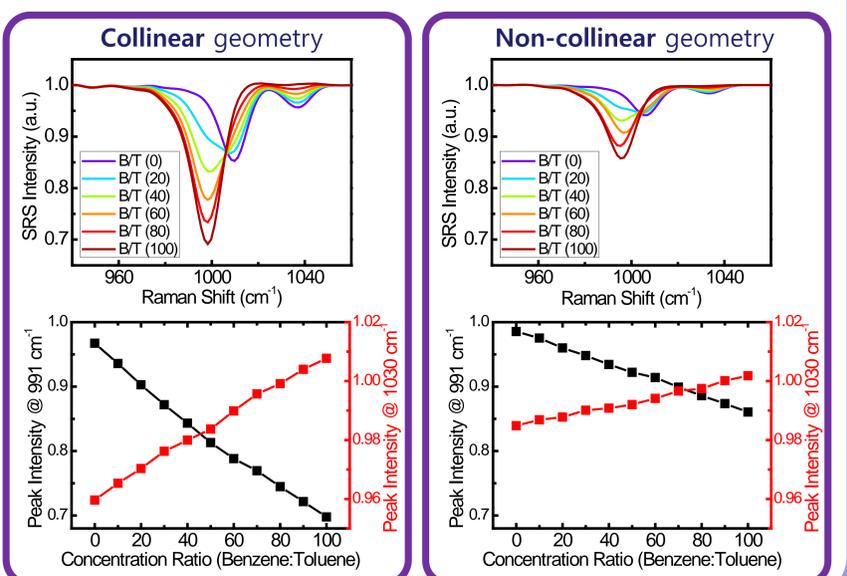
✓ The stimulated Raman spectra (upper) are well correlated with spontaneous Raman spectra (lower).

✓ We represent SRS intensity ratio between spontaneous and stimulated Raman spectra.

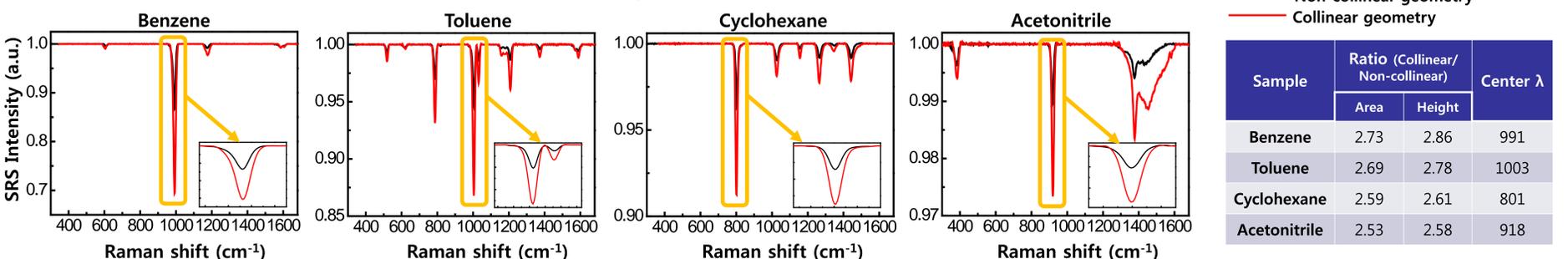
## SRS intensity ratio between spontaneous and stimulated Raman spectra



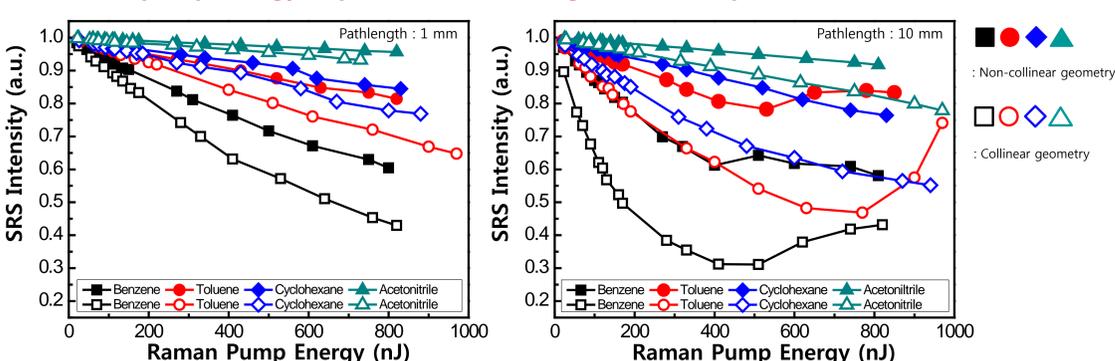
## Concentration dependent SRS spectra Benzene and Toluene



## Different SRL spectra between Non-collinear and Collinear geometries



## Raman-pump energy dependence of SRS signal of 4 samples



## Conclusion

- ✓ From the concentration dependence of mixture, we expect that **SRS spectroscopy method is possible to do quantitative experiment.**
- ✓ The power dependence of various molecules exhibits the quantitatively expected results in that **it showed a linear intensity growth.**
- ✓ However, at Raman pump powers above 400 nJ and 10 mm pathlength, the SRL spectra changes dramatically. The results were inconclusive and difficult to interpret because **the SRL spectra includes unpredictable pump-induced Optical Kerr Effect (OKE) or any other non-resonant contributions.**
- ✓ The SRS intensity using **collinear geometry** is **~2.6 times greater** than the SRL intensity using non-collinear geometry. Therefore, we can recommend this geometrical method for biological imaging.