Using the spatially chirped Broadband Pulse to Measure the Narrowband Spectrum

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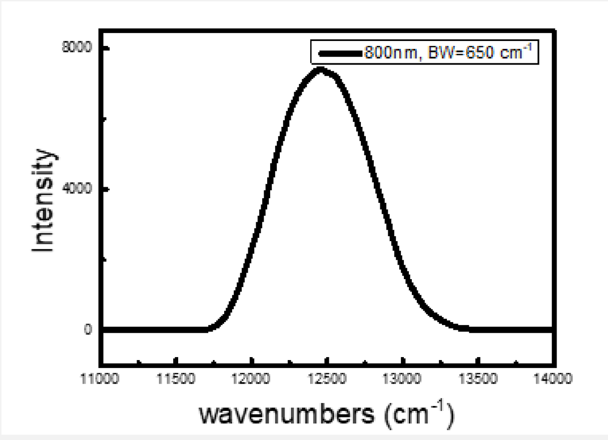
Introduction

The ultrashort laser pulse covers a very broad frequency band. When collecting the narrowband vibrational spectrum, such as sum-frequency vibrational spectrum, if two broadband laser beams are directly used, this can result in overlapping signals that are not resolvable. A filter is frequently used to obtain a narrow-band pulse to improve the resolution. This is inevitably accompanied by a decrease in the pulse energy detected. In this work, with the dispersive power of a prism, we produced a set of resolvable sum frequency spectra by using two broad-band laser pulses.

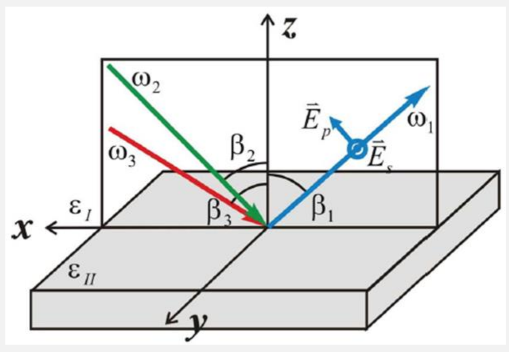
I. Nonlinear Spectroscopy

Strong filed → Nonlinear effect

$t_{narrowband}$ —Fourier transform→ $\omega_{broadband}$



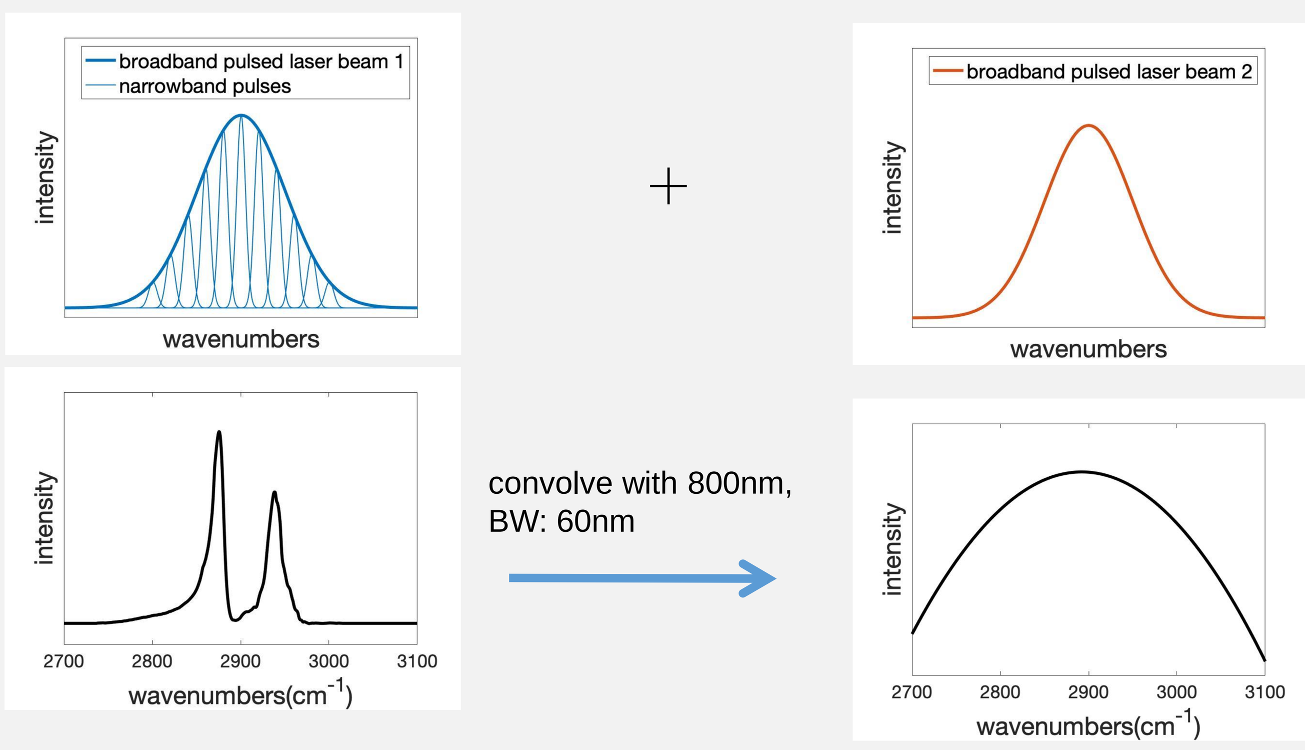
Sum-frequency generation



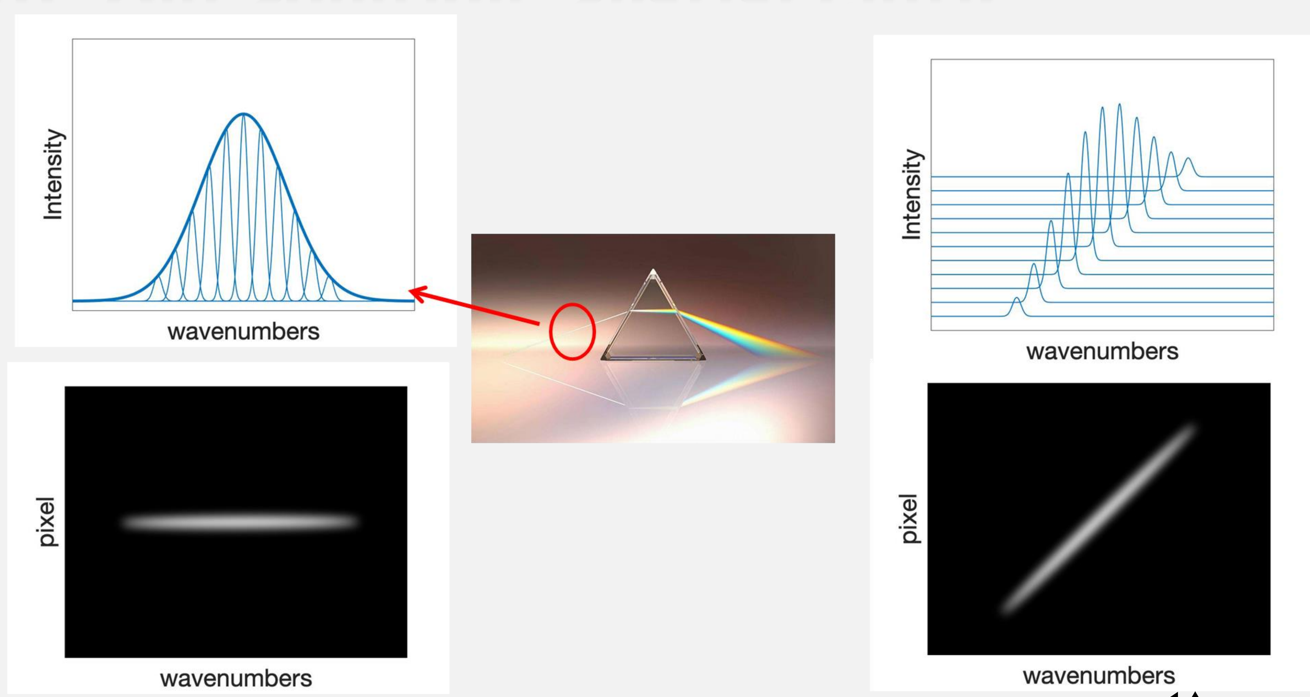
$\omega_1=\omega_2+\omega_3$

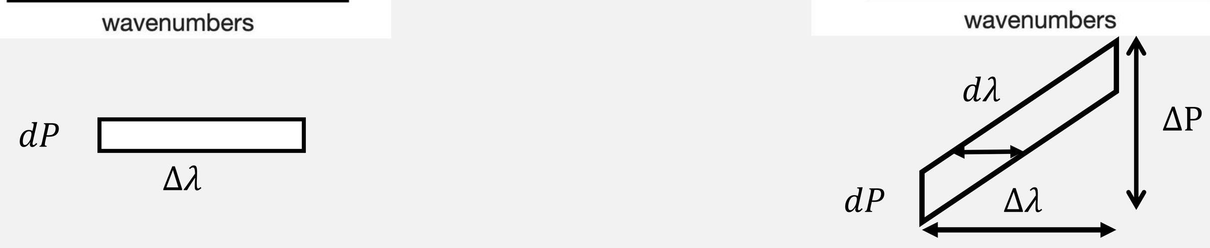
	Wavenumbers
vibration mode of molecular	10^1 cm^{-1}
femtosecond laser	10^2 cm^{-1}

II. The difficulty in using broadband pulse



III. Our solution: spatial chirp



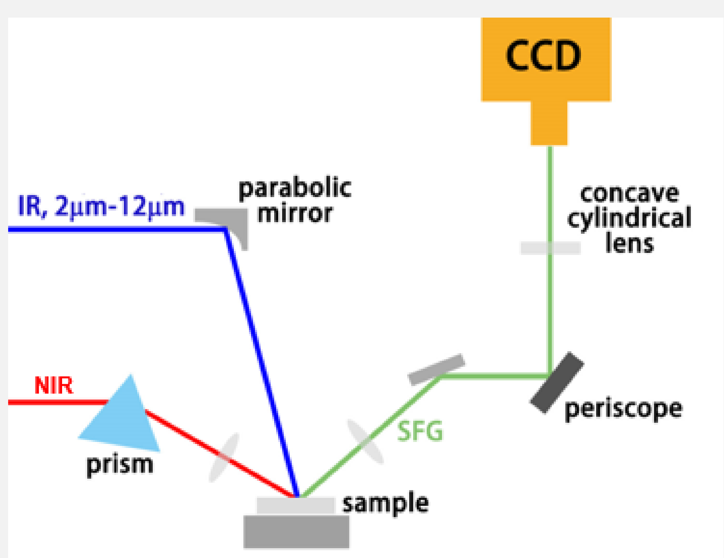


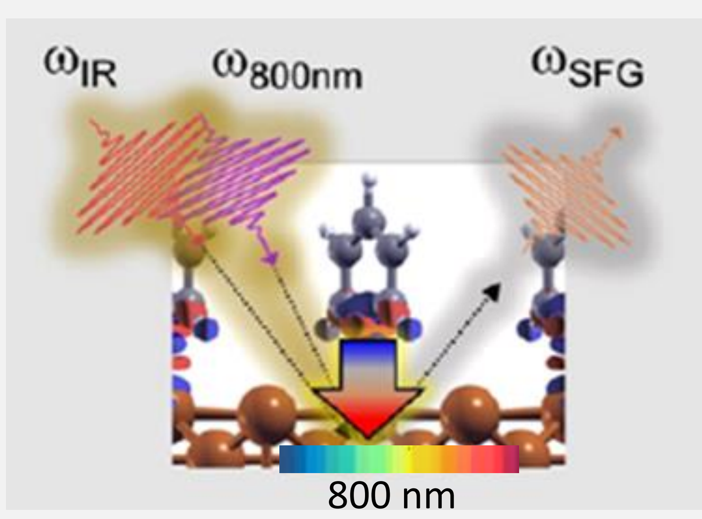
dP: width of spot on sample

ΔP: the size of image in spectrograph

$$d\lambda \cdot \Delta P = dP \cdot \Delta\lambda \rightarrow d\lambda = \Delta\lambda \cdot \frac{dP}{\Delta P}$$

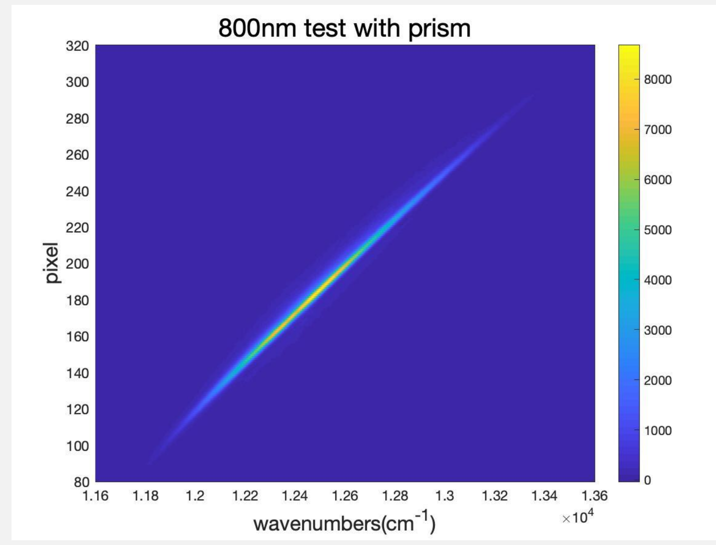
IV Experimental setup

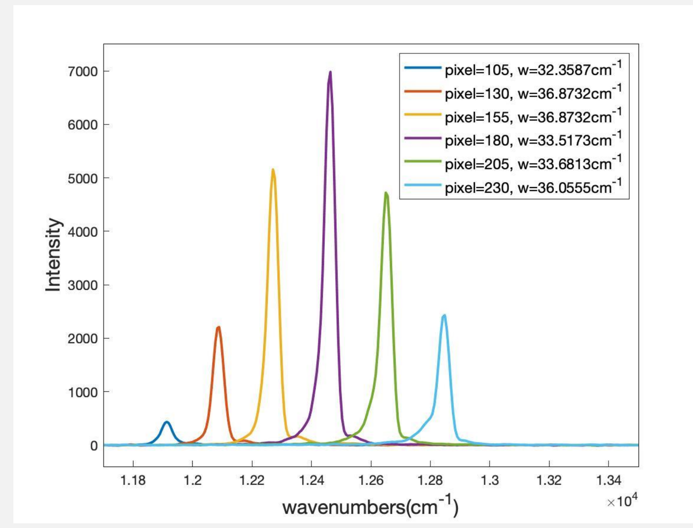




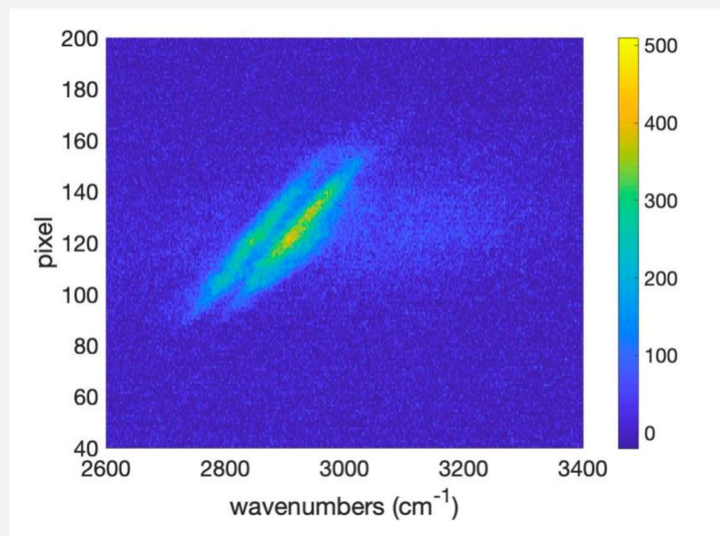
V Experimental result

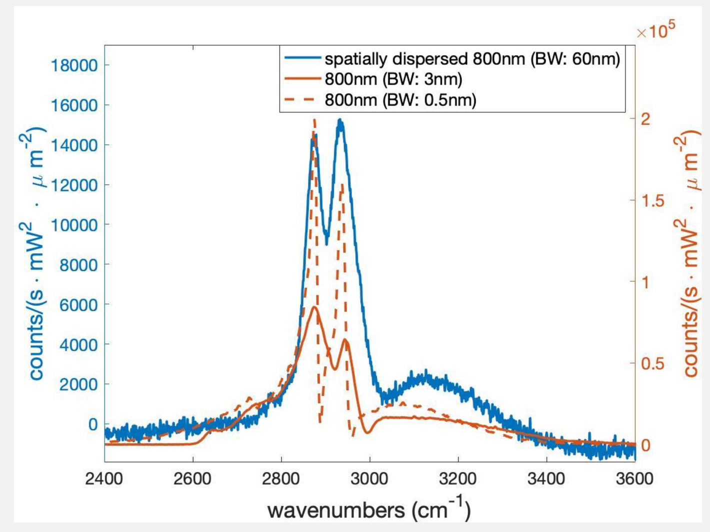
1. The dispersion of NIR



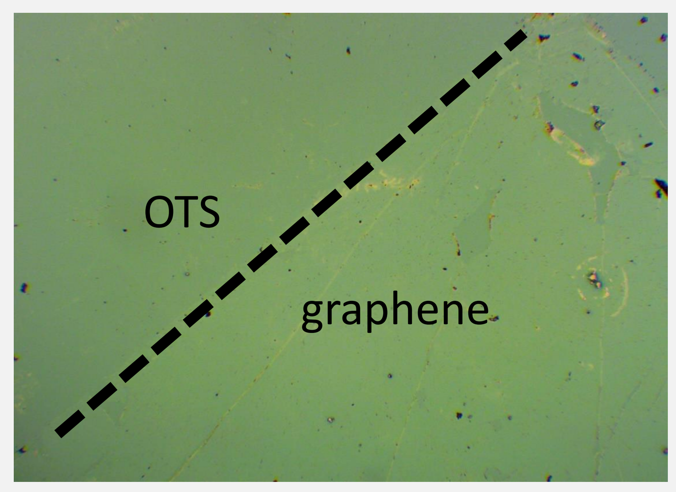


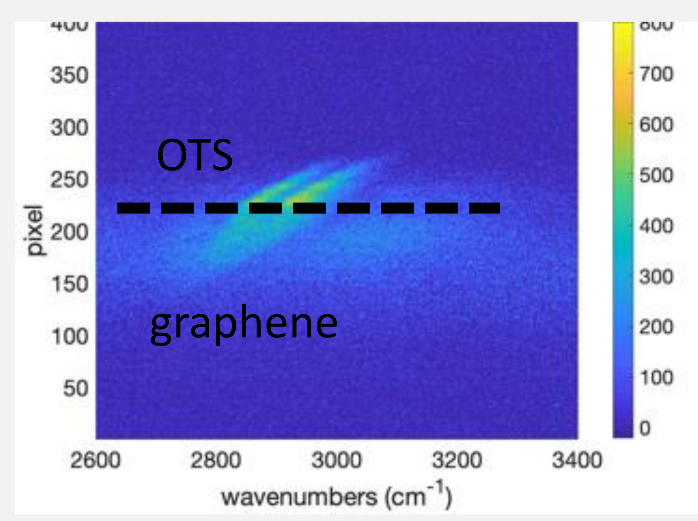
2. The SFG of OTS

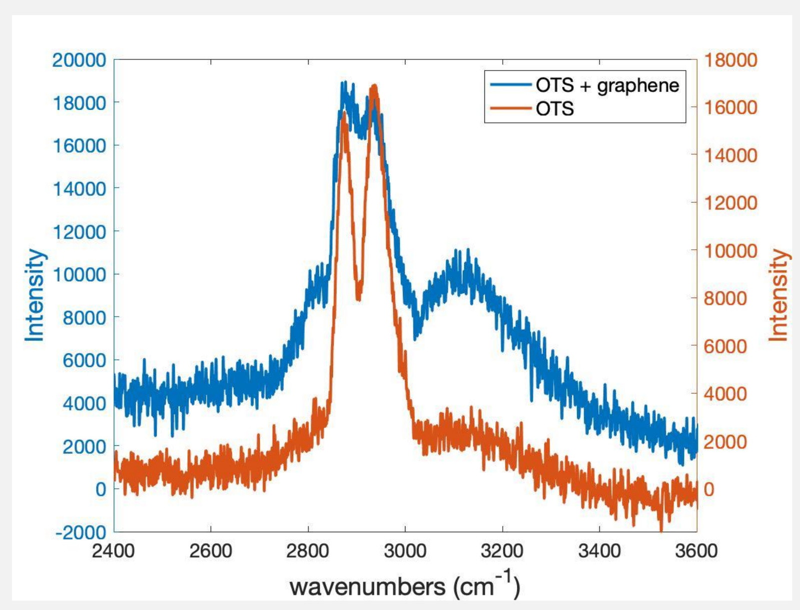




3. In this way, we can get a spectrum with spatial resolution







Compared with the OTS, the spectrum of graphene shows a significant broadening

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energy transfer: between the graphene and CH3 group on the tail of OTS

VI. Conclusion

1. We propose a new experimental method for measuring narrow band spectrum.
2. The experimental method is suitable for measuring imaging spectrum.

VII. Reference

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