Using the spatially chirped Broadband Pulse to Measure the Narrowband Spectrum

H. Li[1], Y. Y. Zhao[1], W. T. Liu[2]

1. Department of Physics, Fudan University, Shanghai 200433, China

Abstract: 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 paper, with the dispersive power of a prism, we produced a set of resolvable sum frequency spectra by using two broad-band laser pulses. We first separated the different frequency bands of a broadband laser pulse spatially, which was then overlapped with a broadband infrared light without chirping on the sample. We obtained the spectrum of each spatial point through imaging, and then obtained the resolvable sum-frequency spectrum through simple calculation. Because the energy of the broadband laser pulse can be fully used, the signal intensity and the signal-to-noise ratio can be improved greatly.

Reference

[1] X. D. Zhu , H. Suhr , Y. R . Shen Surface vibrational spectroscopy by infrared-visible sum-frequency generation (A)[J]. Physical Review B Condensed Matter, 1987, 35(6):3047.

[2] J. H. Hunt , P. Guyo- Sionnest , Y. R. Shen, Observation of C-H stretch vibrations of monolayers of molecules optical sum-frequency generation[J]. Chemical Physics Letters, 1987, 133(3):189-192.

[3] P. Guyot-Sionnest, R. Superfine, J. H. Hunt, Y. R. Shen, Vibrational spectroscopy of a silane monolayer at air/solid and liquid/solid interfaces using sum-frequency generation[J]。Chemical Physics Letters，1988，144(1):1-5.

[4] J. Lobau, K. Wolfrum, A. Romphorst, et al. Adsorption of alkyl-trichlorosilanes on glass and silicon: A comparative study using sum-frequency spectroscopy and XPS[J]。Thin Solid Films，1996，289(1–2):272-281.

[5] S. Ye, S. Nihonyanagi, K. Uosaki, Sum frequency generation (SFG) study of the pH-dependent water structure on a fused quartz surface modified by an octadecyltrichlorosilane (OTS) monolayer[J]. Physical Chemistry Chemical Physics, 2001, 3(16):3463-3469.

[6] J. A. Mcguire, W. Beck , X. Wei , et al. Fourier-transform sum-frequency surface vibrational spectroscopy with femtosecond pulses[J]. Optics Letters, 1999, 24(24):1877.

[7] J. A. Mcguire, Y. R. Shen, Signal and noise in Fourier-transform sum-frequency surface vibrational spectroscopy with femtosecond lasers[J]. Journal of the Optical Society of America B, 2015, 23(2):363-369.