Surface Sum-Frequency Spectroscopy Covering the New Terahertz Gap

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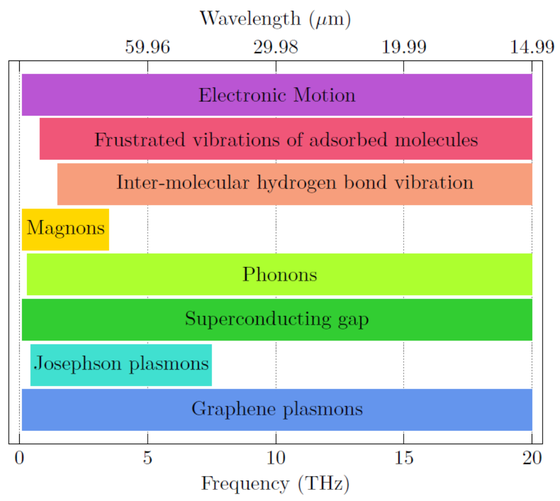
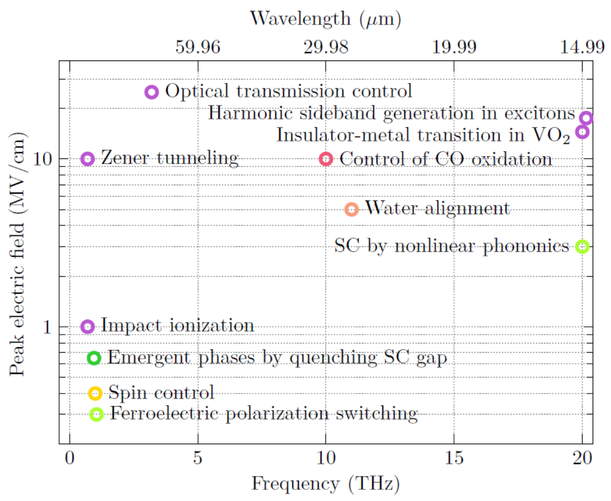
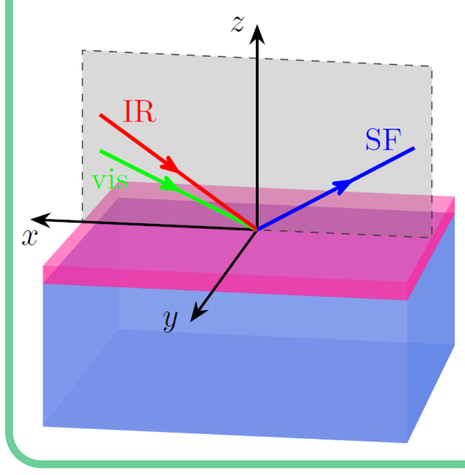
Introduction

◇ New Physics in Terahertz Range



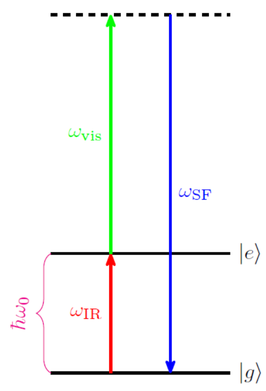


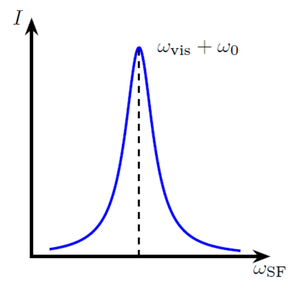
◇ Sum-Frequency Spectroscopy (SFS)



$\chi^{(2)} \neq 0$

$\chi^{(2)} = 0$

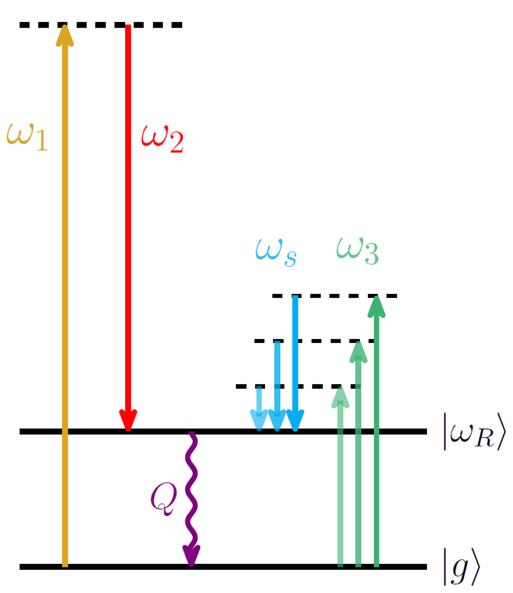


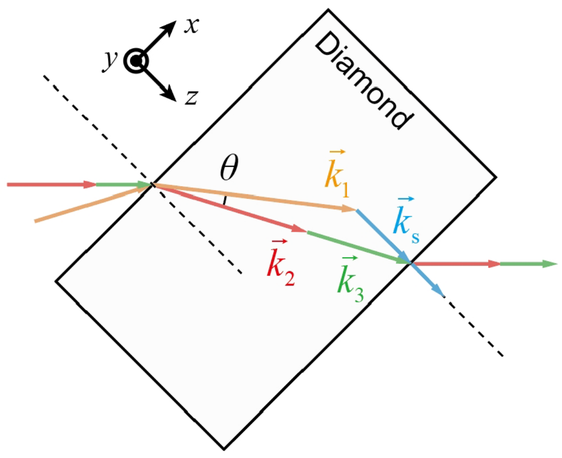


$$\chi^{(2)} = \chi^{(2)}_{\mathrm{NR}} + \sum_q \frac{\mathbf{A}_q}{\omega - \omega_q + \mathrm{i}\Gamma_q}$$

Methods

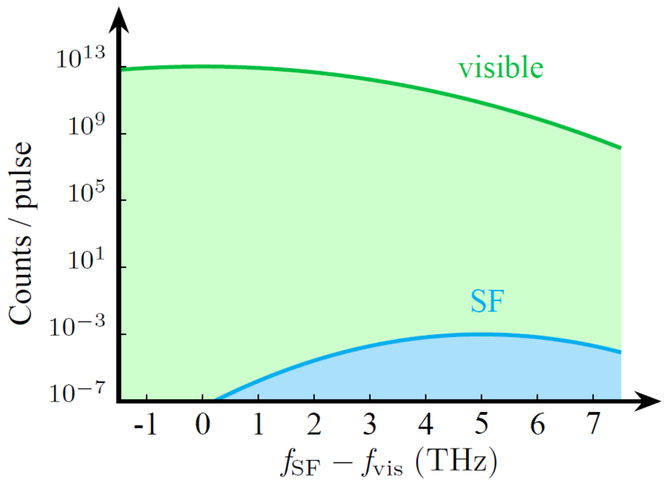
◇ Broadband Tunable THz Light Source

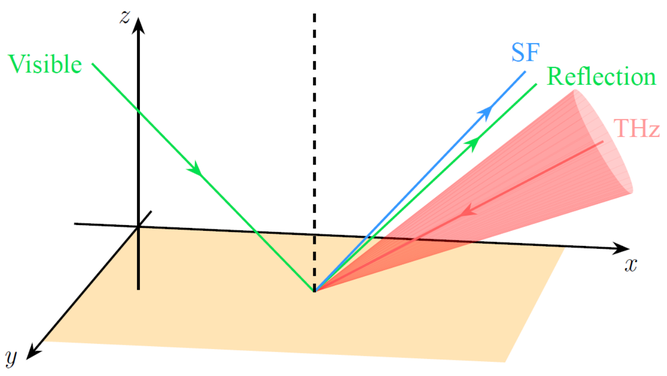


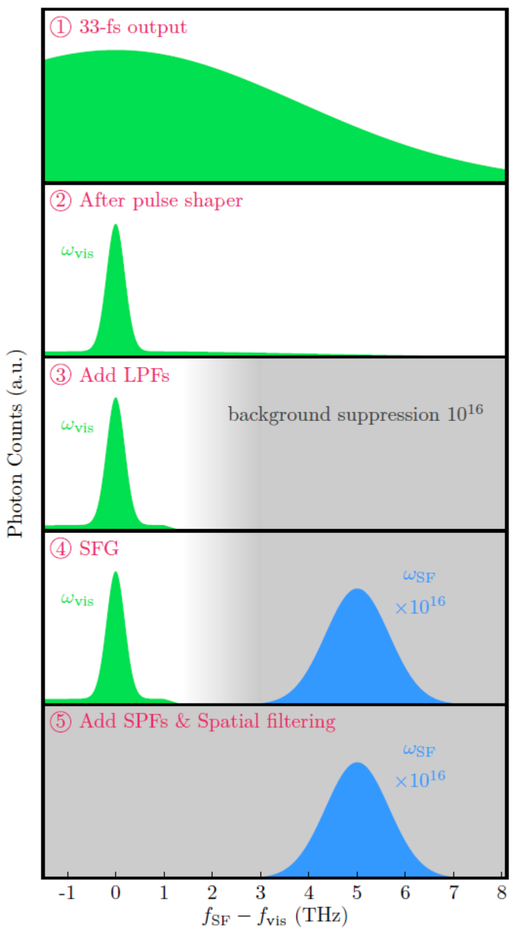


Noncollinear phase matching

◇ Suppression of the Visible Background

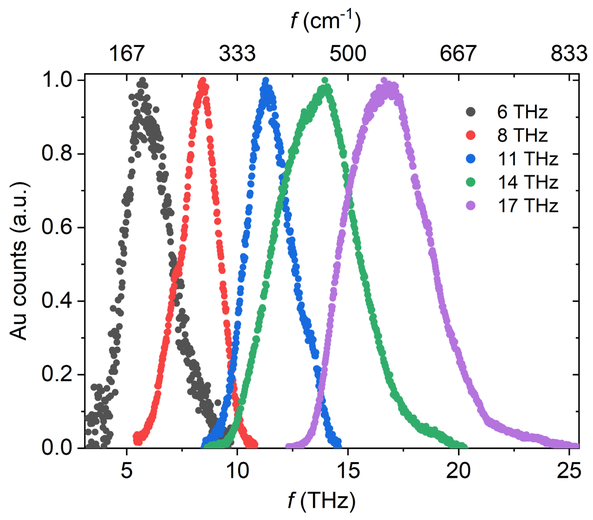




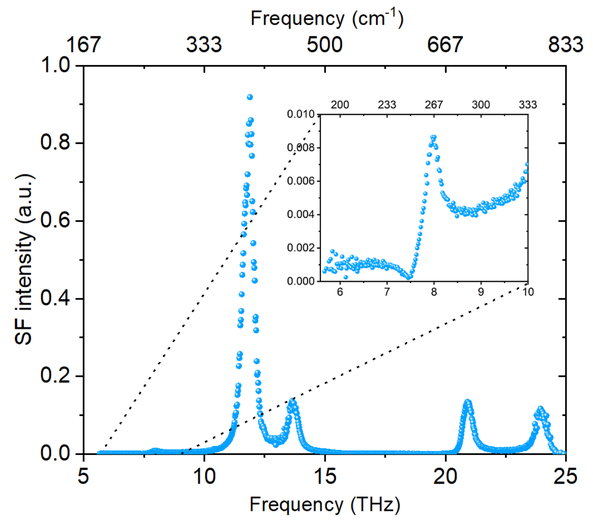


Results

◇ Full Coverage of (5 ~ 20) THz

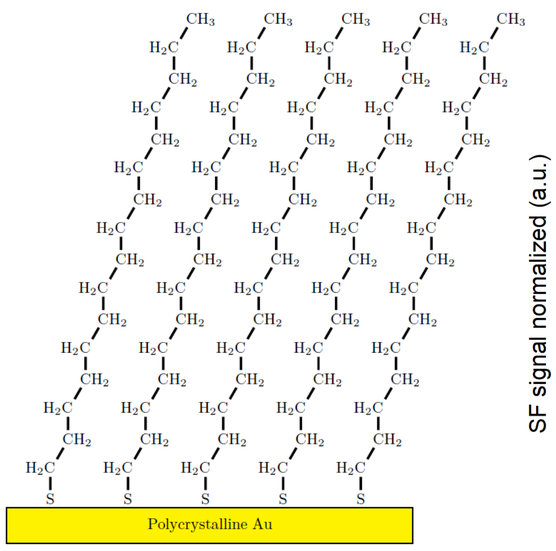


Standard sample: Au

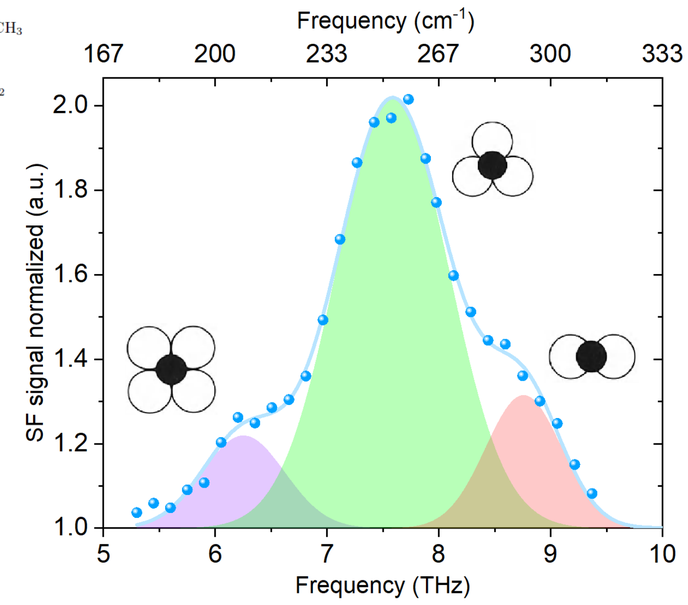


E_g phonons in α-quartz

◇ Monolayer Sensitivity

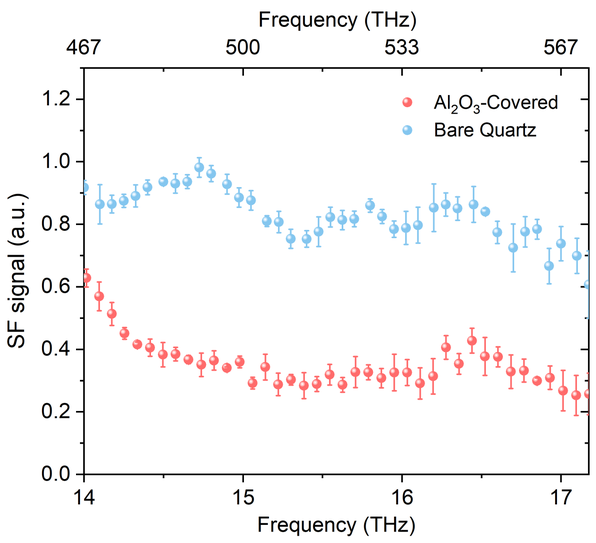


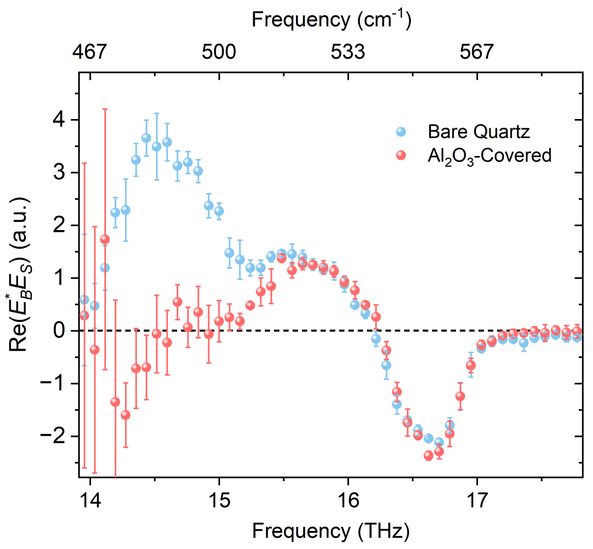
HDT SAM (Self-Assembled Monolayer)



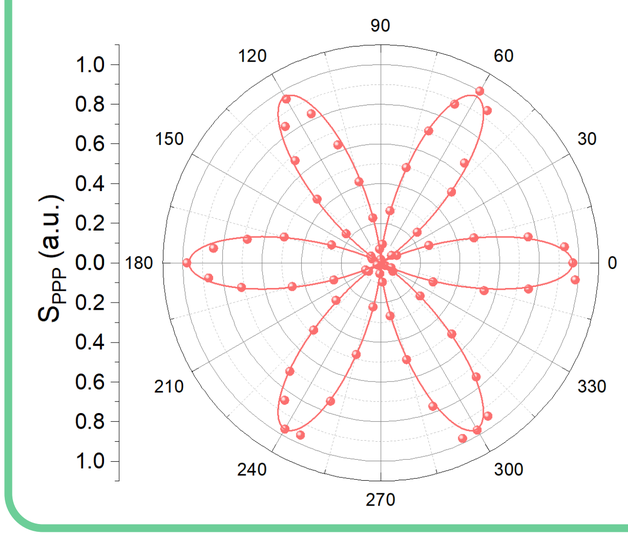
Au-S Stretching modes

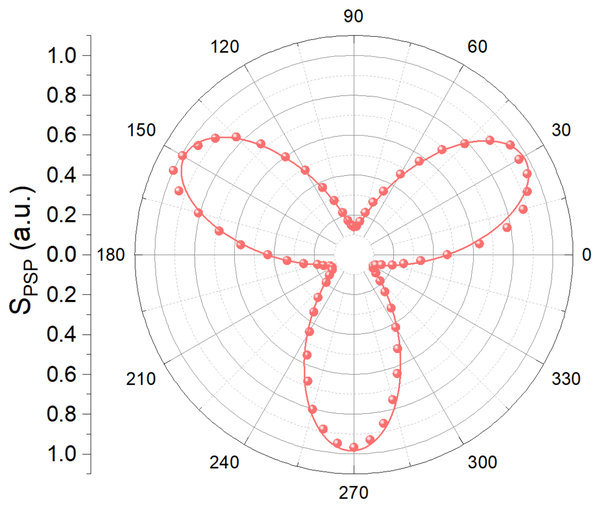
◇ Surface phonons on [0001] α-Quartz





◇ Probing Phonon Chirality in Point Group D_3





Summary

- A new THz-SFVS setup was built, extending the detection range down to 5 THz.
- Monolayer sensitivity was justified by Au-S stretching of thiol SAM on Au.
- Topics of surfaces phonons and phonon chirality were studied by THz-SFVS.