

4° SCIENTIFIC INTERNATIONAL CONFERENCE ON CBRNE

Angle Dependent Stand-Off Raman Spectroscopy on Chemical Warfare Agent Simulants

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Motivation



Global security threat through
CWAs

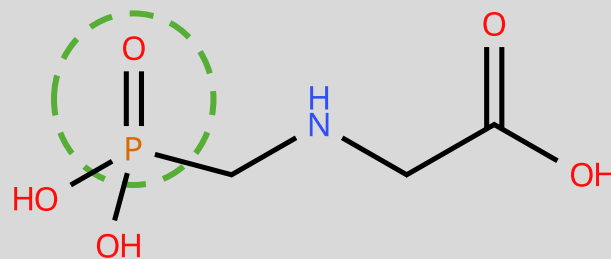


Detection of threats using
standoff
Raman spectroscopy

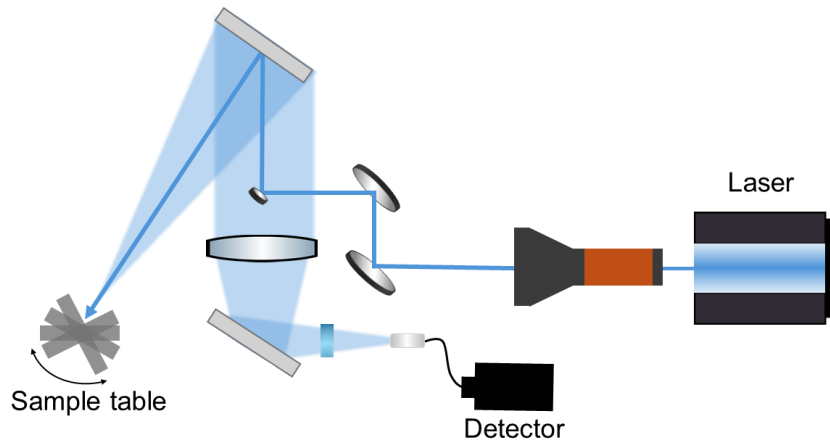
Influencing factors on the Raman signal intensity

- Detection distance
- Excitation wavelength ($\propto 1/\lambda^4$)
- **Detection angle**
- **Polarization of excitation beam**
- Irradiated amount of substance

Glyphosate – a CWA simulant

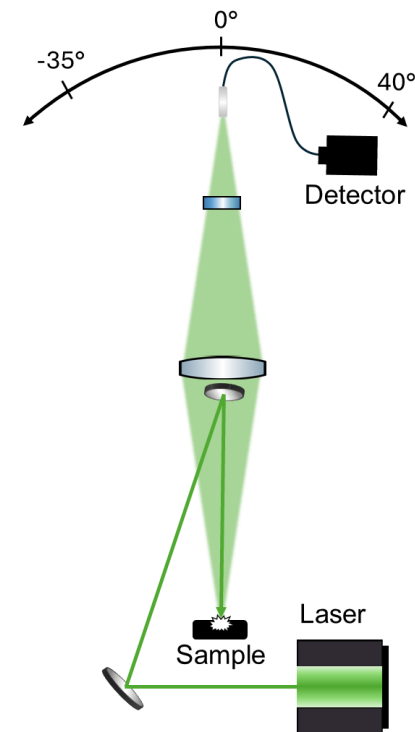


Experimental setups



266 nm pulsed excitation

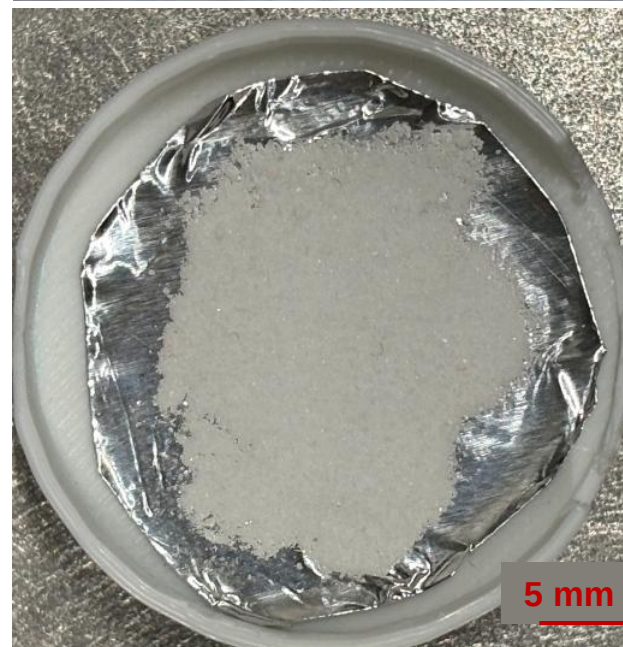
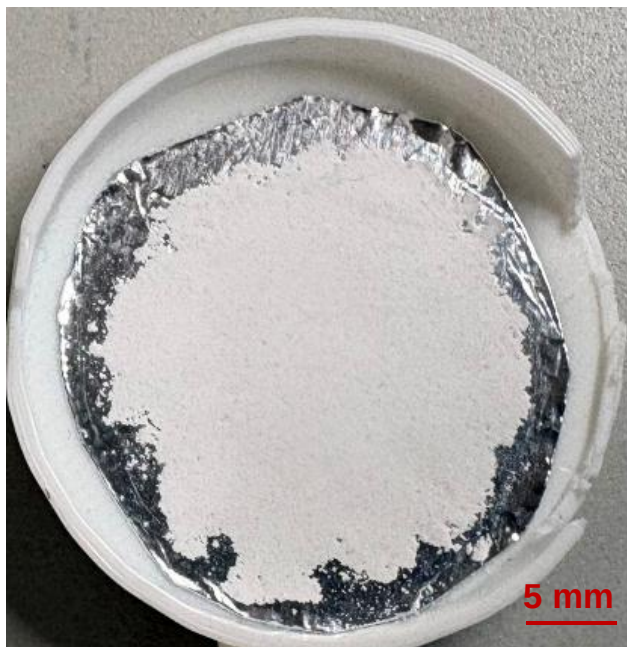
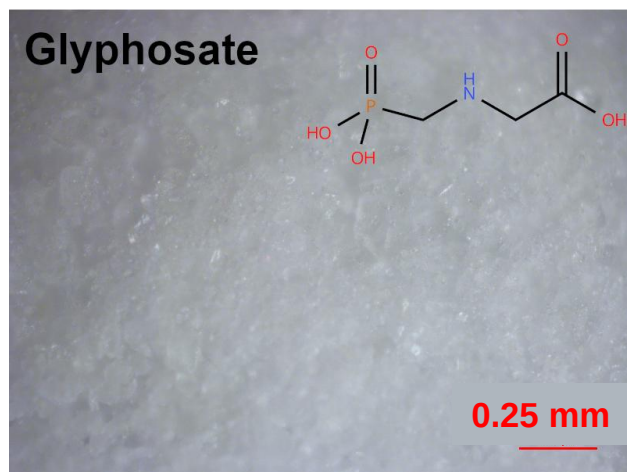
- Laser diameter: 1 mm
- Detection distance: 64 cm
- Detection angles: -48° to $+9^\circ$
- 16 spectra per angle



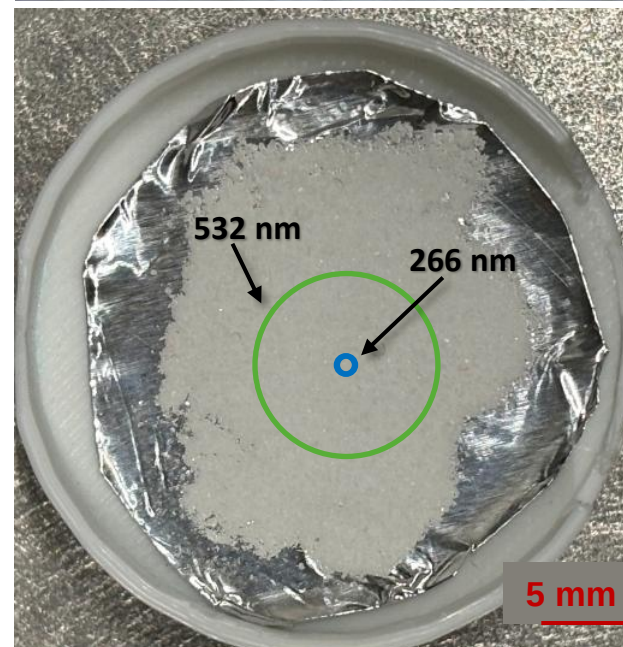
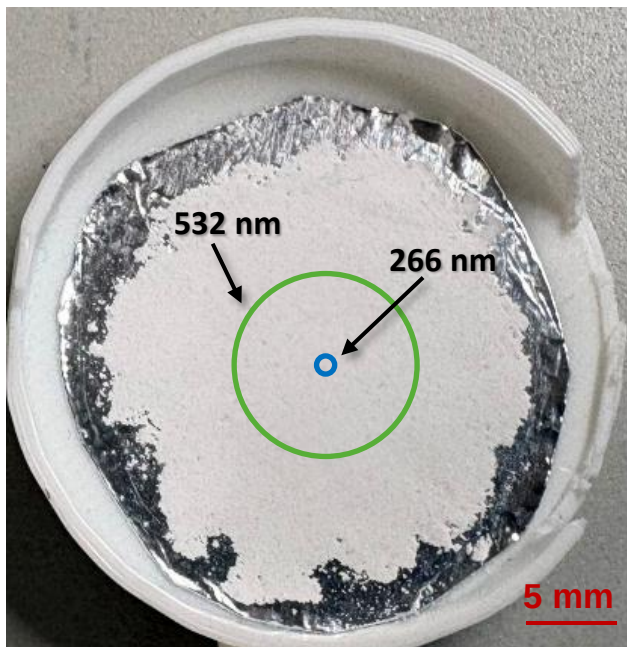
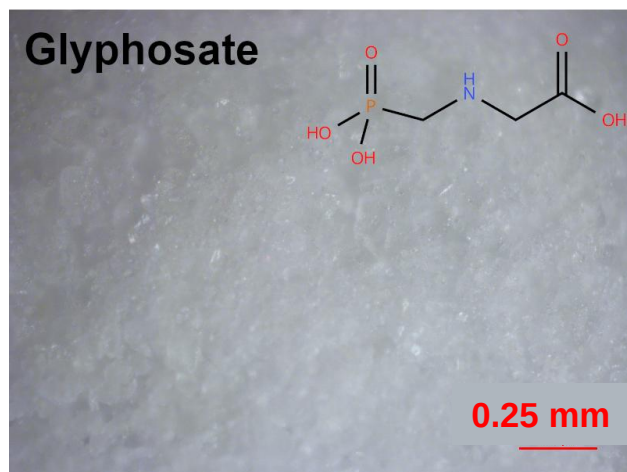
532 nm pulsed excitation

- Laser diameter: 10 mm
- Detection distance: 50 cm
- Detection angles: -35° to $+35^\circ$
- 2 spectra per angle

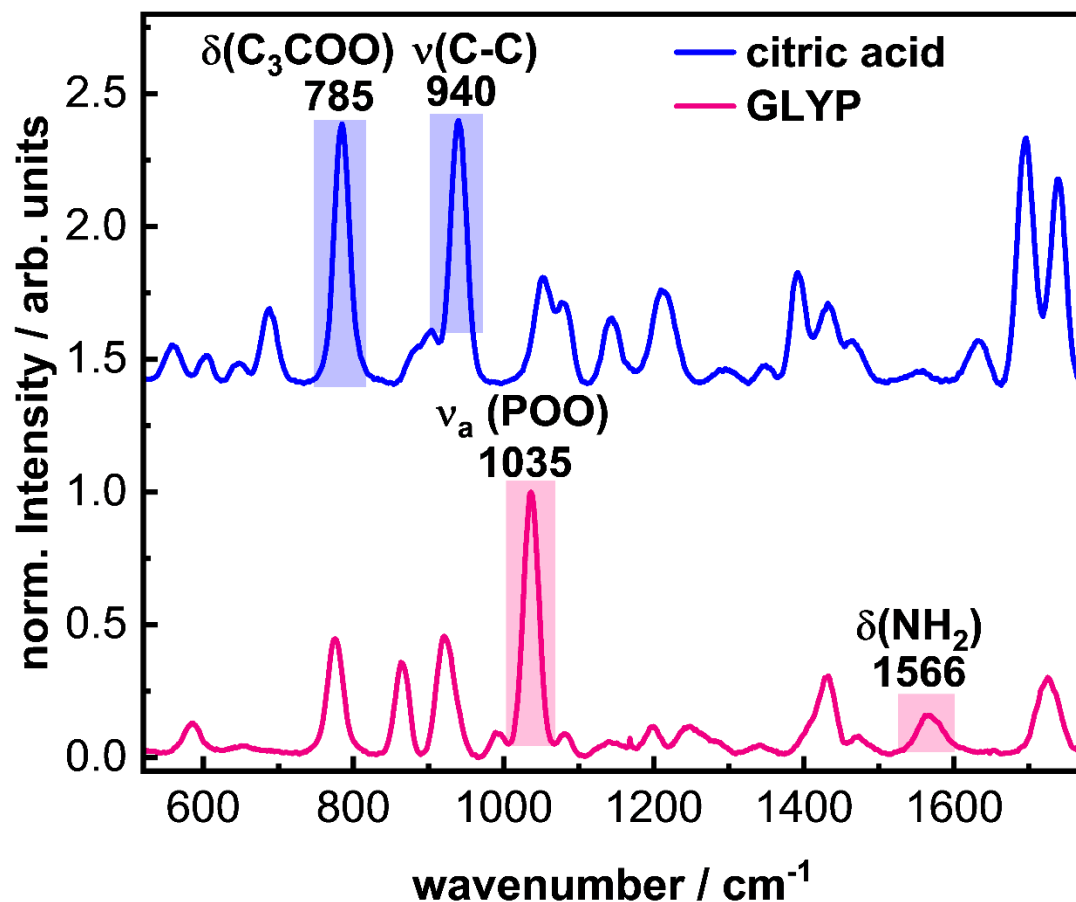
Samples



Samples



Raman Spectra of Glyphosate and Citric Acid

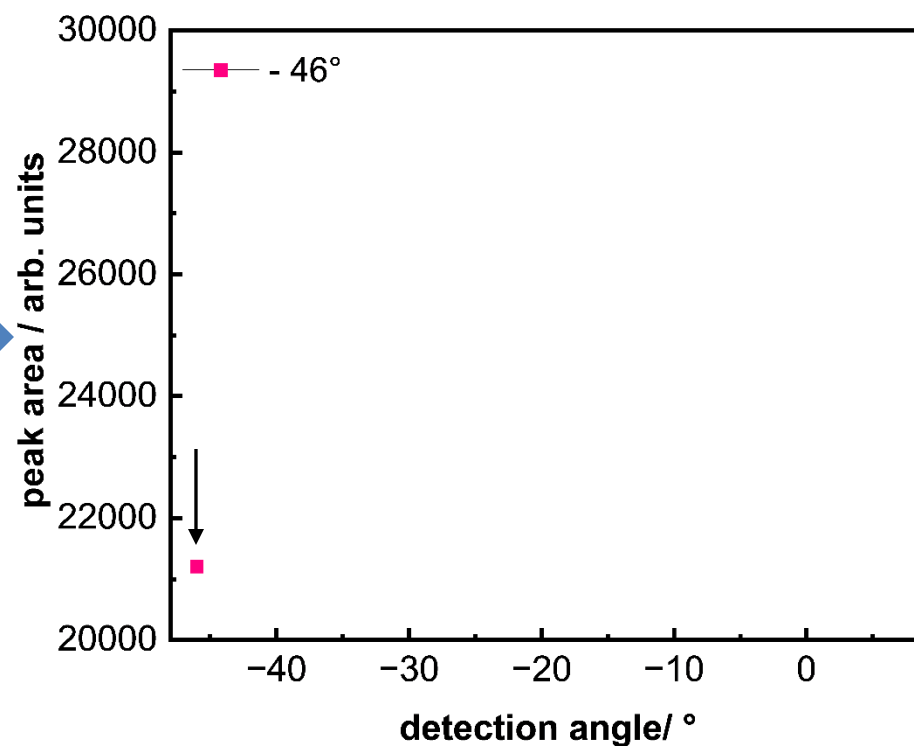
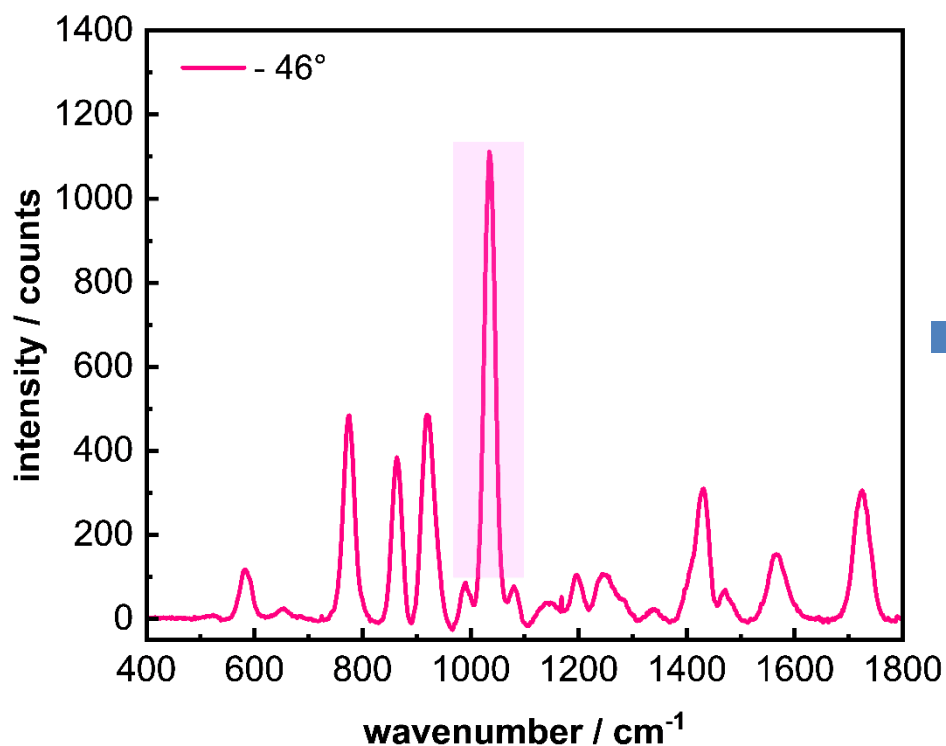


266 nm excitation wavelength

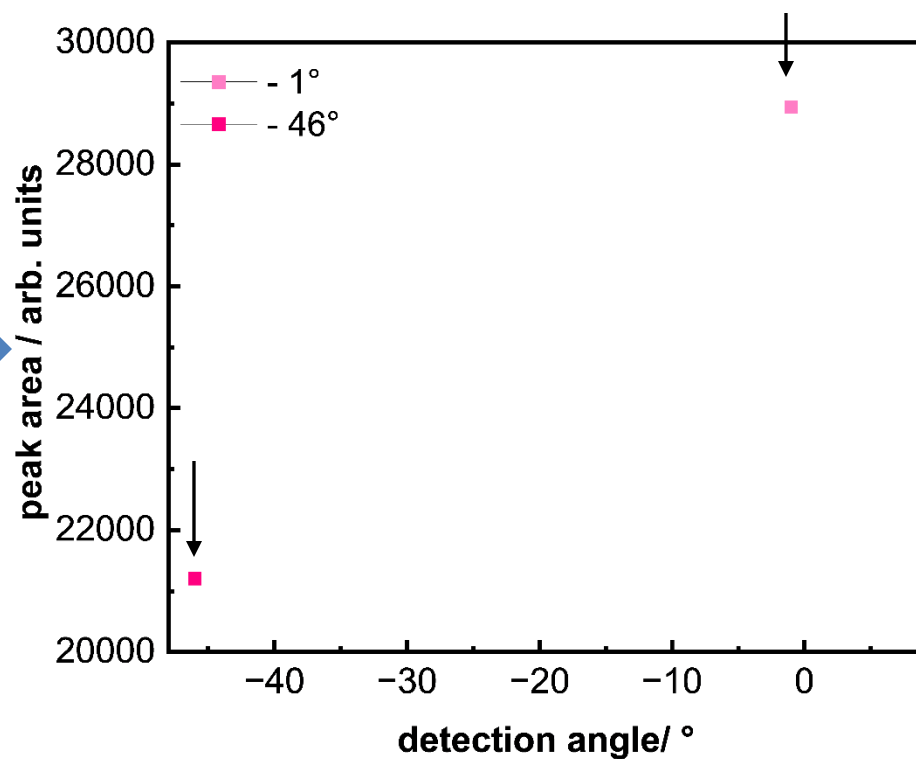
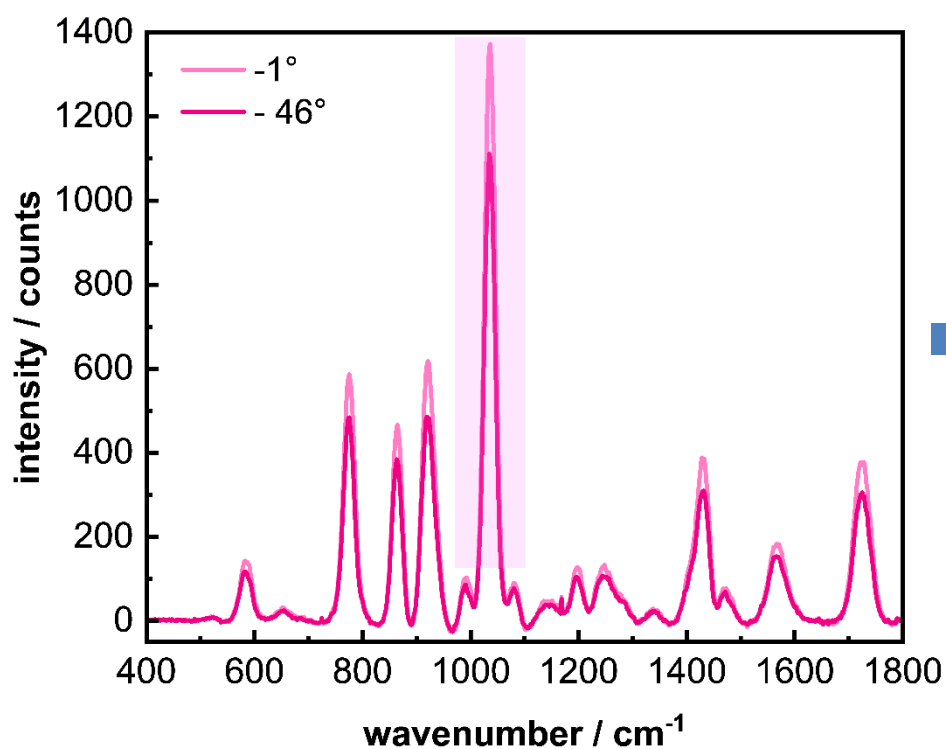
Peak analysis

- **Citric acid:**
 - $\delta(\text{C}_3\text{COO})$ deformational vibration
 - $\nu(\text{C-C})$ stretching vibration
- **Glyphosate:**
 - $\nu(\text{POO})_{\text{asym}}$ stretching vibration
 - $\delta(\text{NH}_2)$ deformational vibration

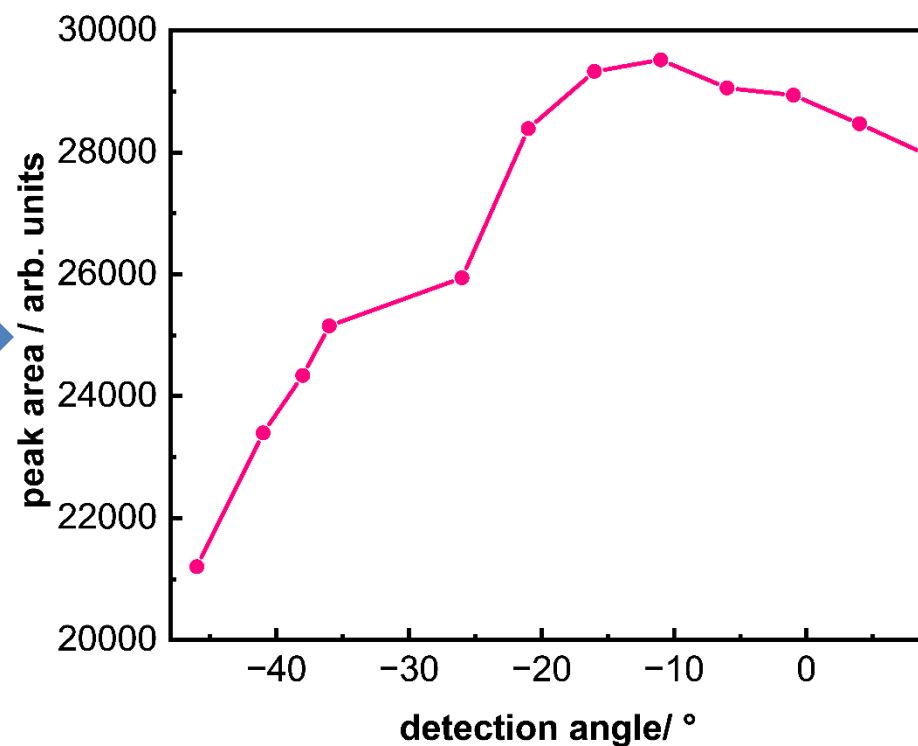
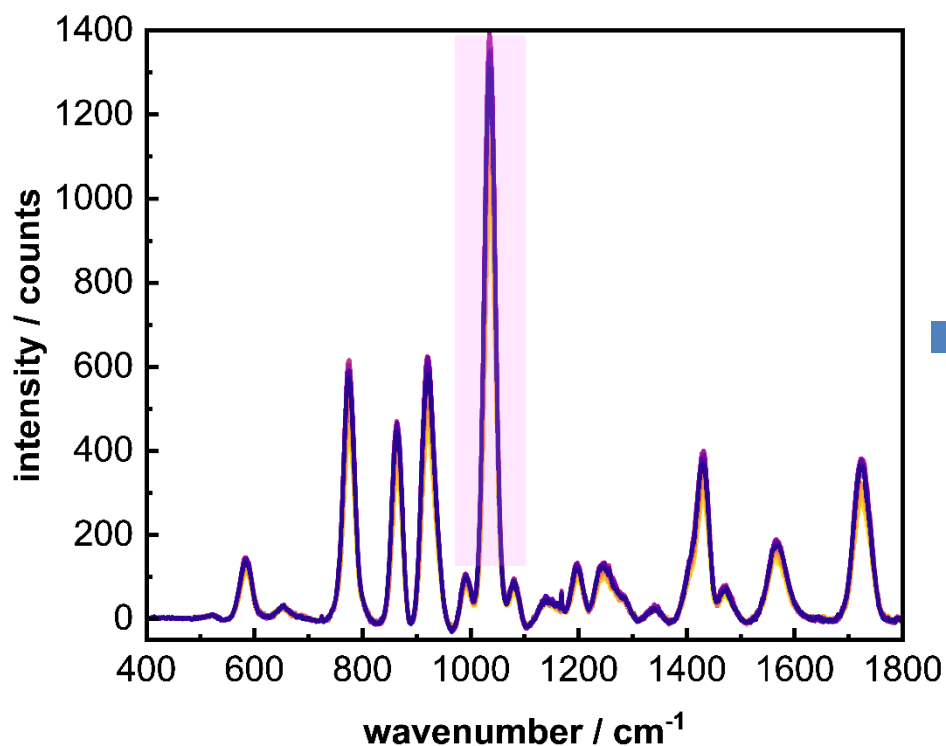
Raman Spectra of Glyphosate



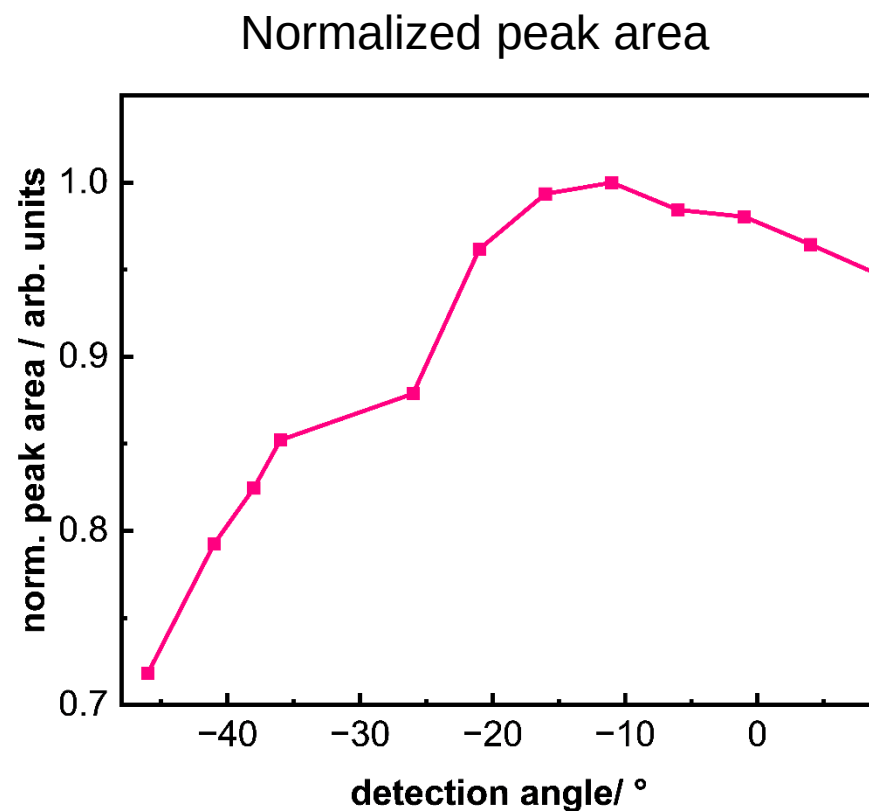
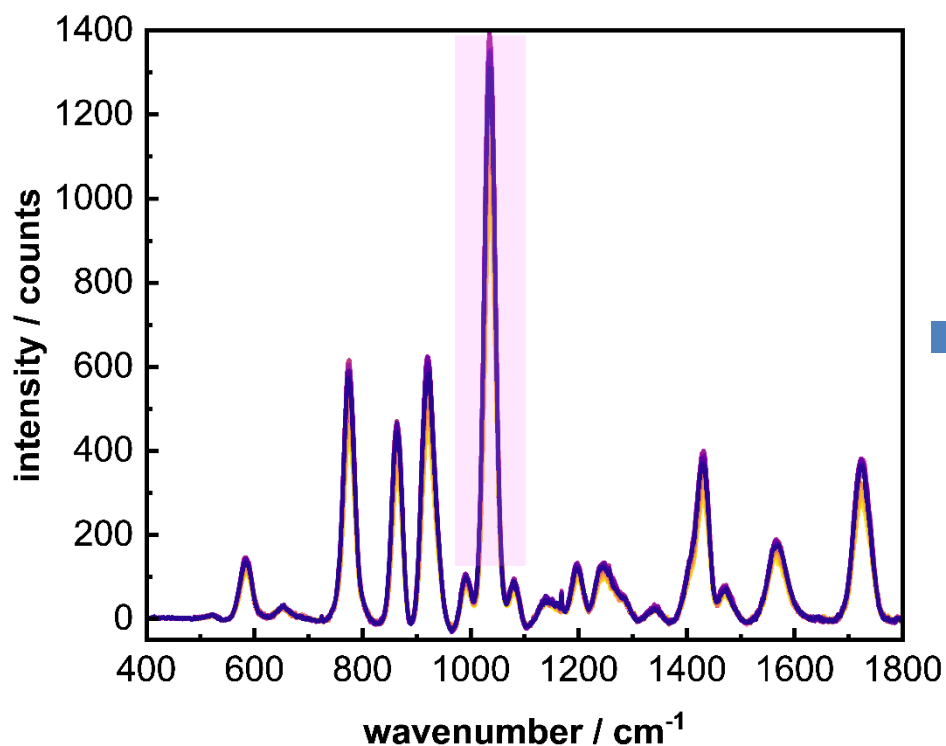
Raman Spectra of Glyphosate



Raman Spectra of Glyphosate

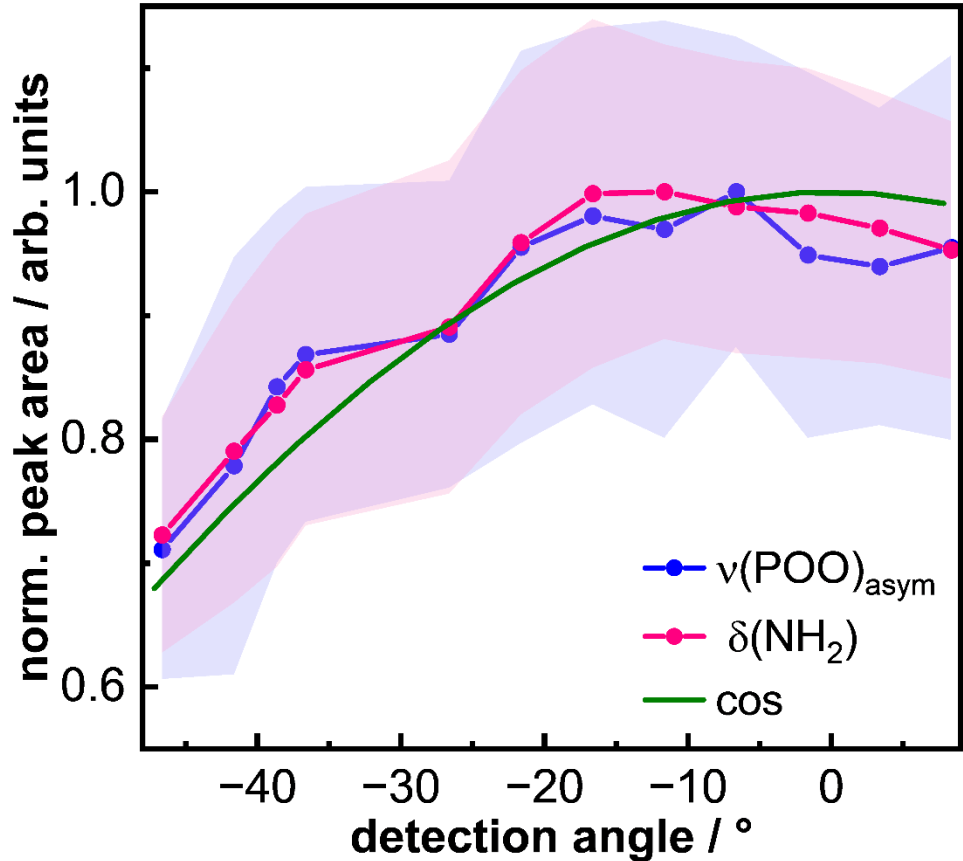


Raman Spectra of Glyphosate



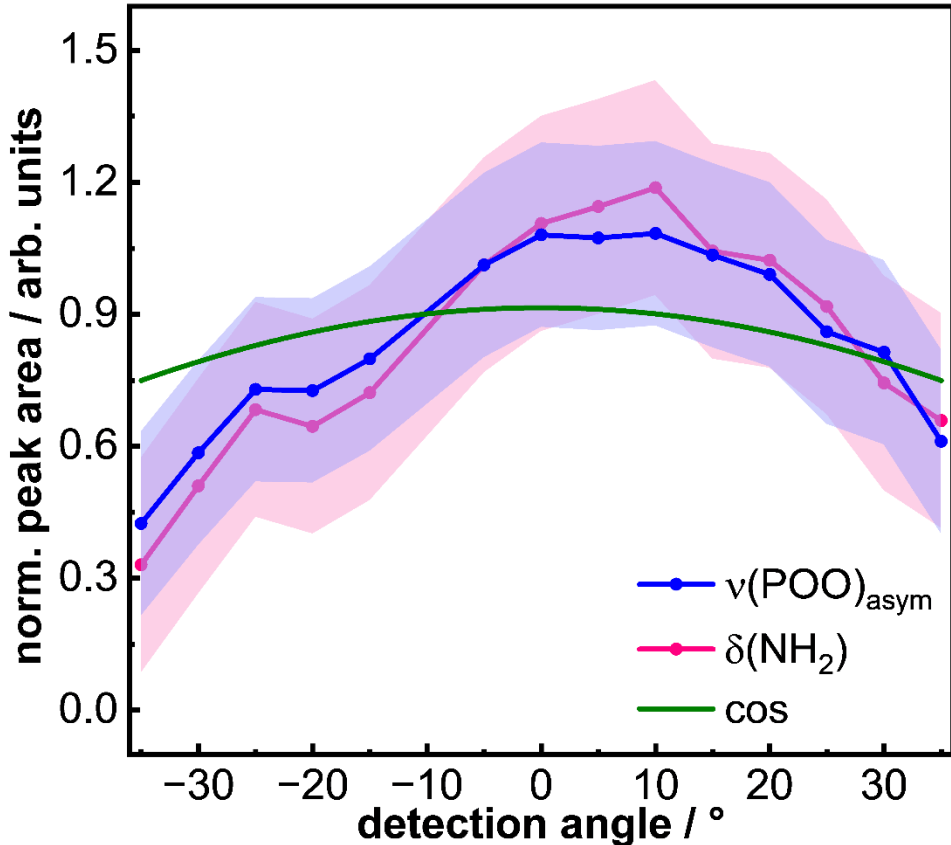
Glyphosate

266 nm excitation



similar to cos curve

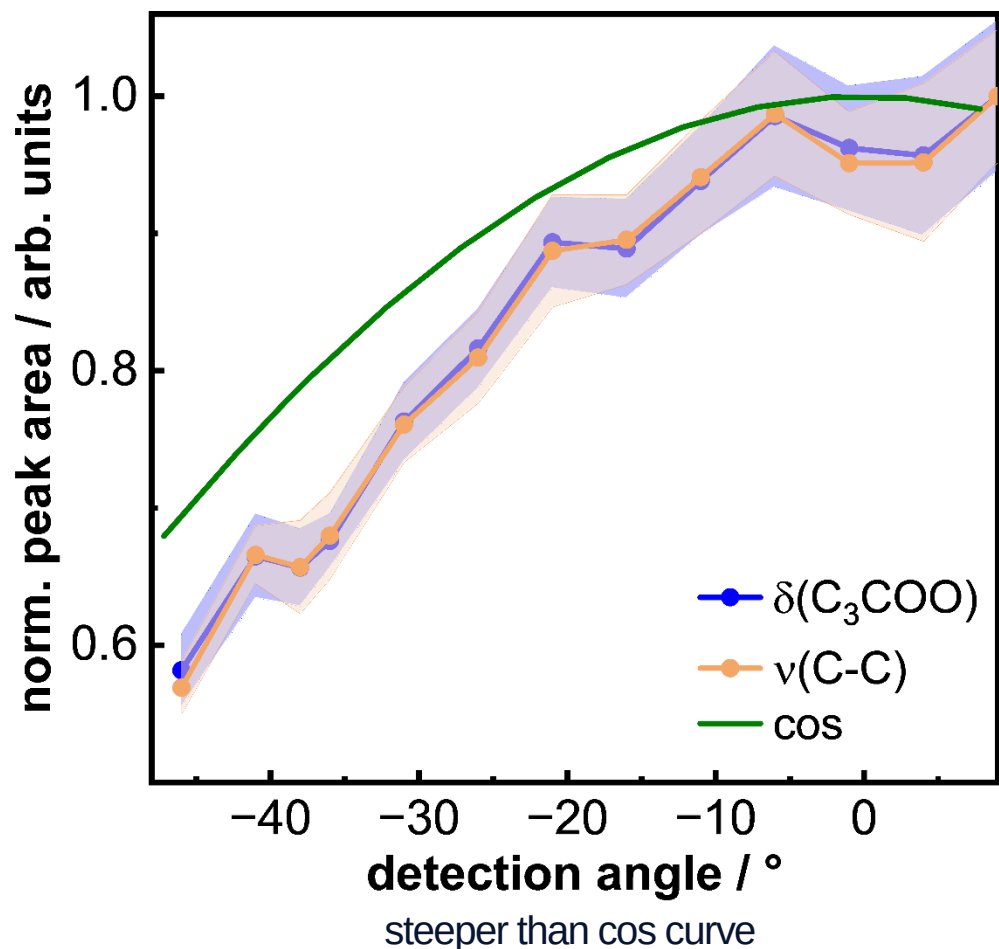
532 nm excitation



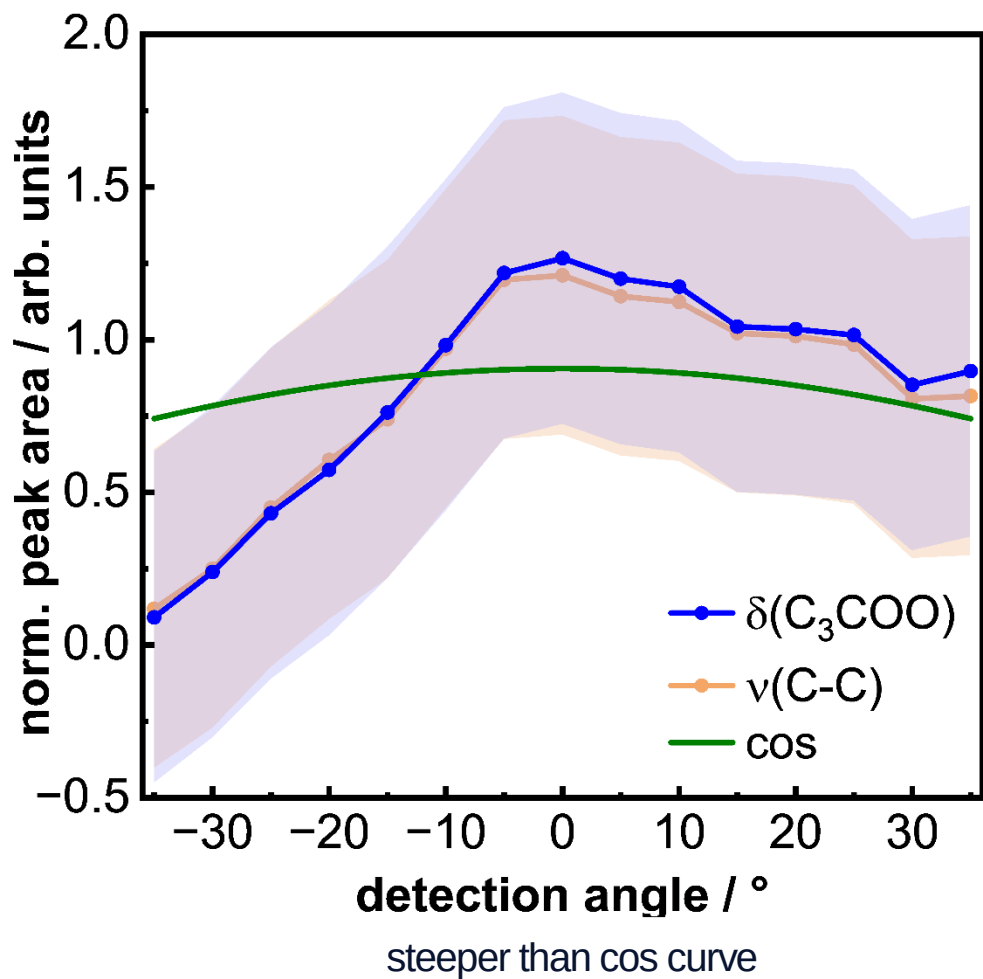
steeper than cos curve

Citric Acid

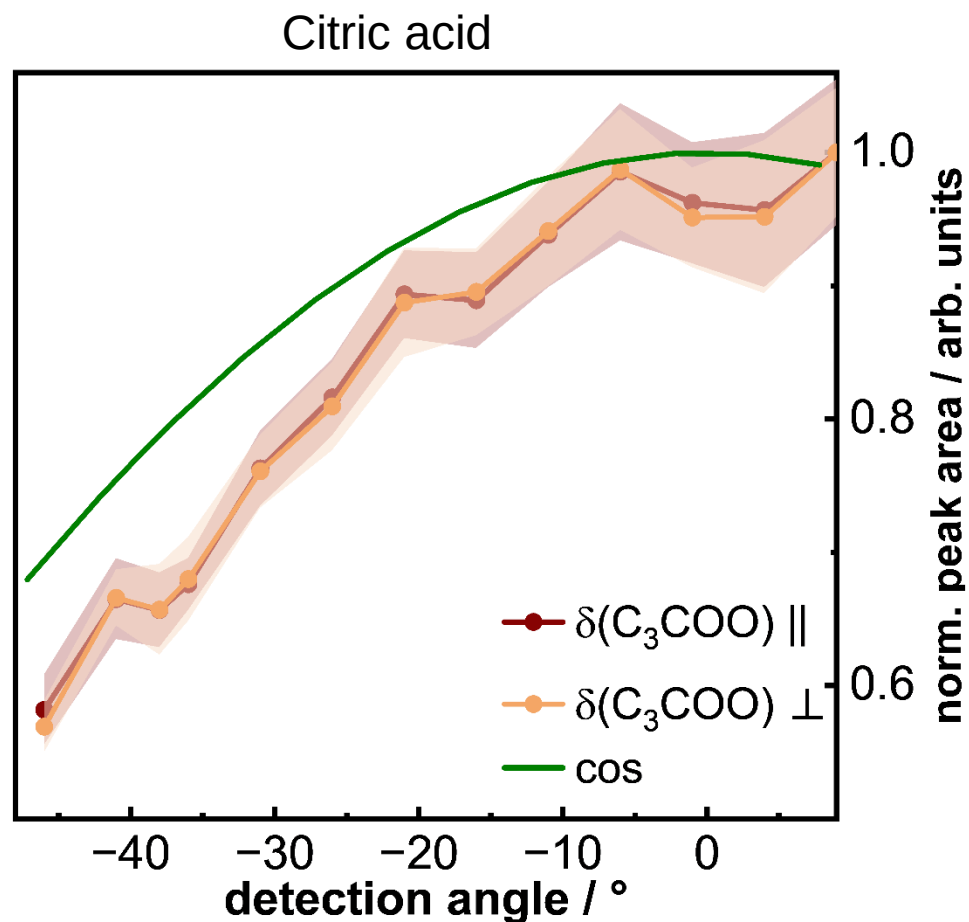
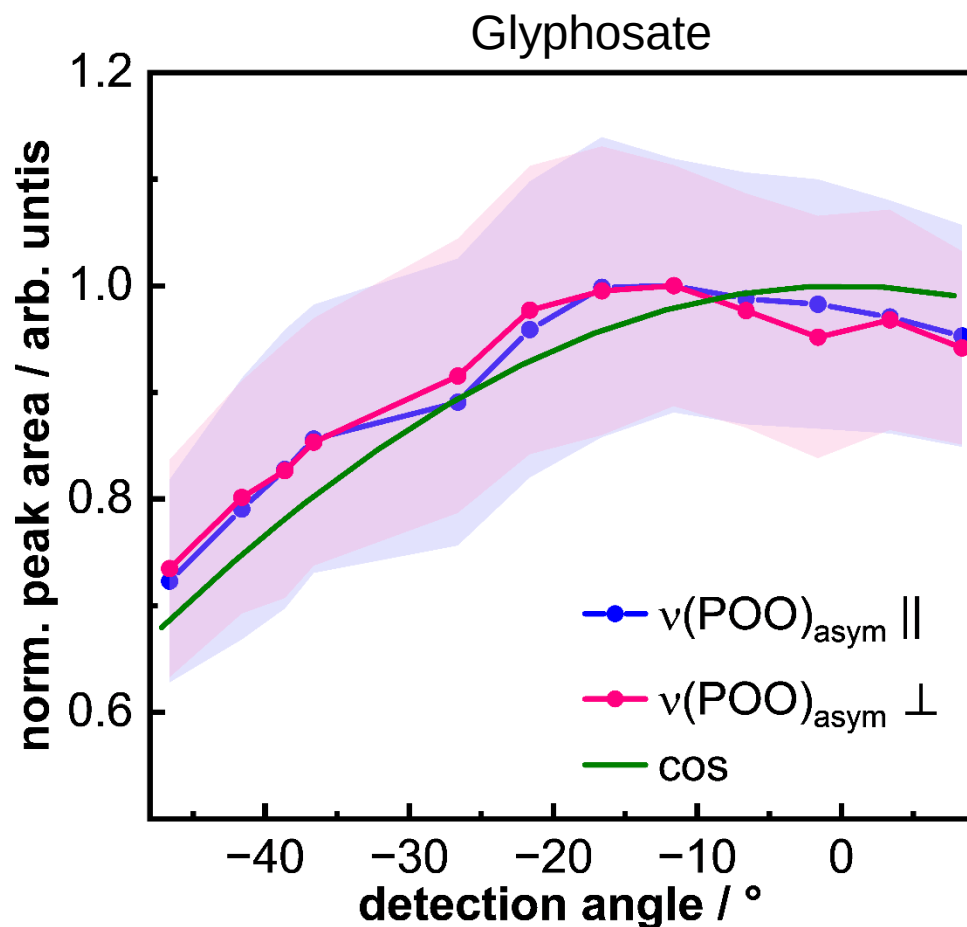
266 nm excitation



532 nm excitation



Polarization dependent measurements for 266 nm excitation



||: vertical polarization
 $\perp$: horizontal polarization

no polarization dependency

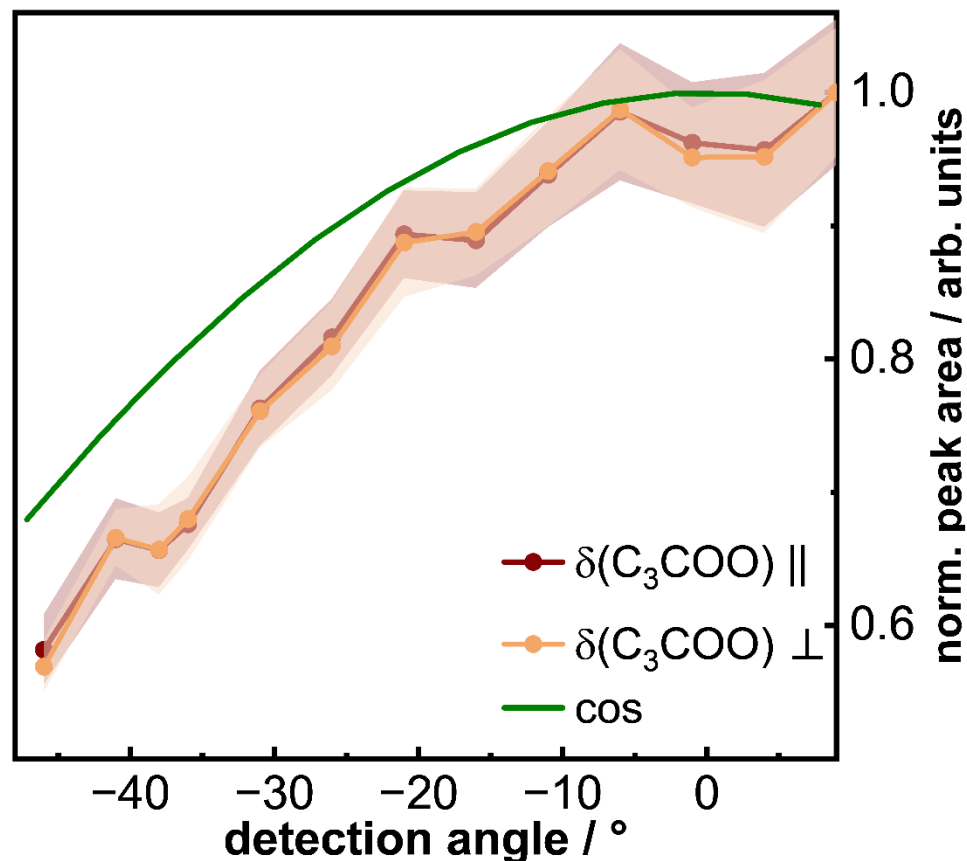
13

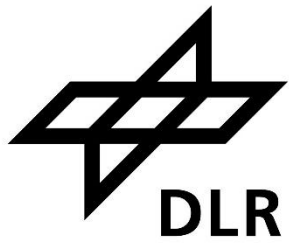
Conclusion

- **clear angular dependence** of intensity for both substances and excitation wavelengths
- **no influence of polarization** of excitation beam
- no influence of vibrational mode

Outlook

- repeat measurement for 532 nm excitation → test reproducibility
- change laser diameter for 532 nm excitation
- test on more substances





Thank you for your attention!

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