Infrared chemical imaging through nondegenerate two-photon absorption in silicon-based cameras

David Knez[1], Adam M. Hanninen[1], Richard C. Prince[2], Eric O. Potma[1, 2], Dmitry A. Fishman[1]

[1]Department of Chemistry, University of California, Irvine, CA 92697, USA
[2]Department of Biomedical Engineering, University of California, Irvine, CA 92697, USA

Supplementary Information

Table 1. Specifications for Si photodiode experiments

MIR pulse width	4.1 ps
MIR spot size	250 μm
NIR spot size	300 μm
Detector impedance	1 MOhm
Detector chip size	5 mm
Reverse bias voltage	12 V
MIR wavelength	3388 nm
NIR wavelength	1480 nm

Table 2. Specifications for Si CCD camera experiments

MIR pulse width	4.1 ps
MIR spot size	3 mm
NIR spot size	3.5 mm
Pixel size	6.5 μm x 6.5 μm
CCD active area	1392x1040 pixels
CCD protective window	Fused silica 1.5 mm

Supplemental Figures

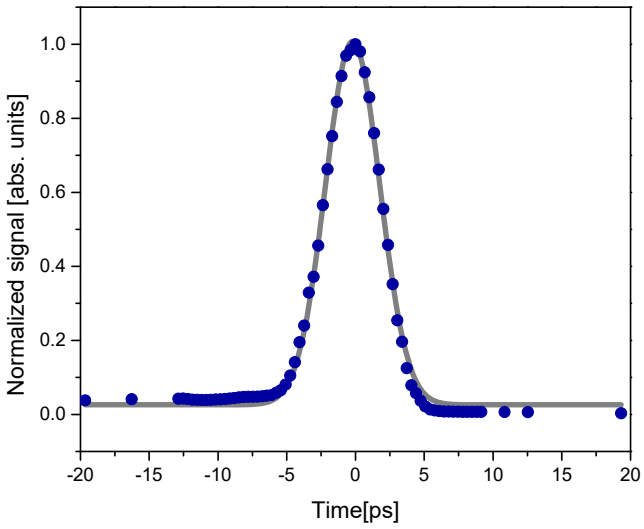

Figure S1. Cross correlation of MIR (3394 nm) and NIR (1478 nm) pulses.

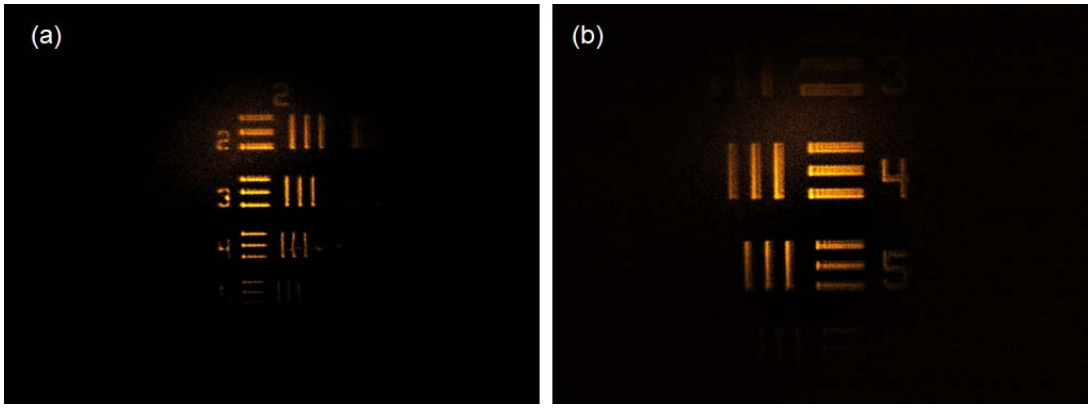

Figure S2. Negative USAF 1951 test chart. (a) column 2, (b) column 1. Image was taken at 2947 cm^{-1}.

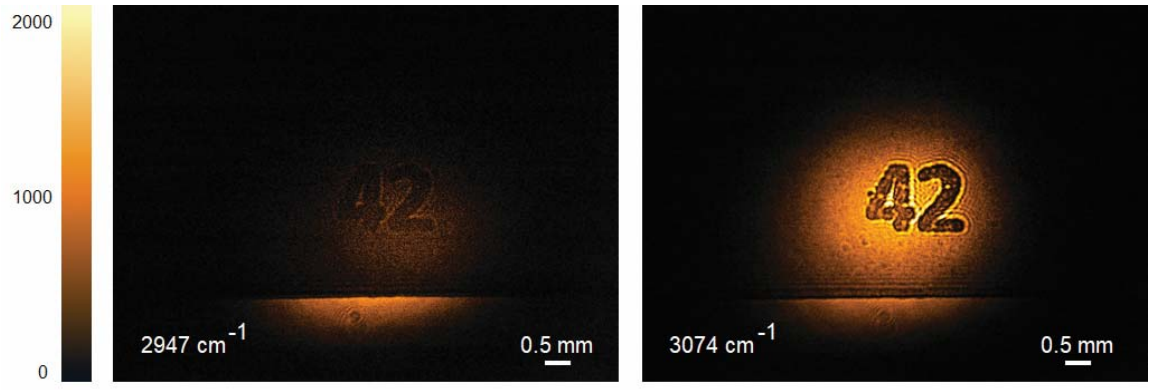

Figure S3. Spectral MIR imaging of a 150 µm cellulose acetate film. The numbers printed with black ink serve as mask to indicate contrast.

Supplemental Movie Files

Movie V1
Real-time movement of a cellulose acetate film strip with printed symbols, both off resonance at 3078 cm^{-1} (V1a) and on resonance at 2949 cm^{-1} (V1b). Movie was acquired with 100 ms exposure time at 5 fps.

Movie V2
Real-time movement of an immersion oil droplet on a CaF_2 surface, on resonance at 2950 cm^{-1}. Contrast arises because of MIR absorption by the droplet. Fresnel and Newton-type interference can be seen near the droplet's edge. Movie was acquired with 100 ms exposure time at 5 fps.

Movie V3
Real-time movement of live *C. elegans* nematodes in D_2O buffer, on resonance at 2950 cm^{-1}.