



## Real-time high-spectral-resolution mid-infrared spectroscopy with a signal-to-noise ratio of ten thousand: supplement

SHUNTARO TANI,<sup>1,\*</sup>  KEI SUGIYAMA,<sup>1</sup> TAKASHI SUKEGAWA,<sup>2</sup>  
TATSURO SATO,<sup>1</sup> YUYA ISHIZUKA,<sup>1</sup> SOICHI TAYA,<sup>1</sup> DAVID FENG,<sup>1</sup>   
OSAMU KOMEDA,<sup>3</sup> HIROYUKI SUTO,<sup>3</sup> HIROAKI SAITOH,<sup>3</sup> AND YOHEI  
KOBAYASHI<sup>1</sup>

<sup>1</sup>*The Institute for Solid State Physics, The University of Tokyo, Kashiwa-no-ha 5-1-5, Kashiwa, Chiba, 277-8581, Japan*

<sup>2</sup>*Canon Inc., 20-2, Kiyohara-Kogyodanchi, Utsunomiya, Tochigi 321-3292, Japan*

<sup>3</sup>*Toyota Technical Center Higashi-Fuji, Toyota Motor Corp., Mishuku 1200, Susono, Shizuoka, 410-1107, Japan*

\**stani@issp.u-tokyo.ac.jp*

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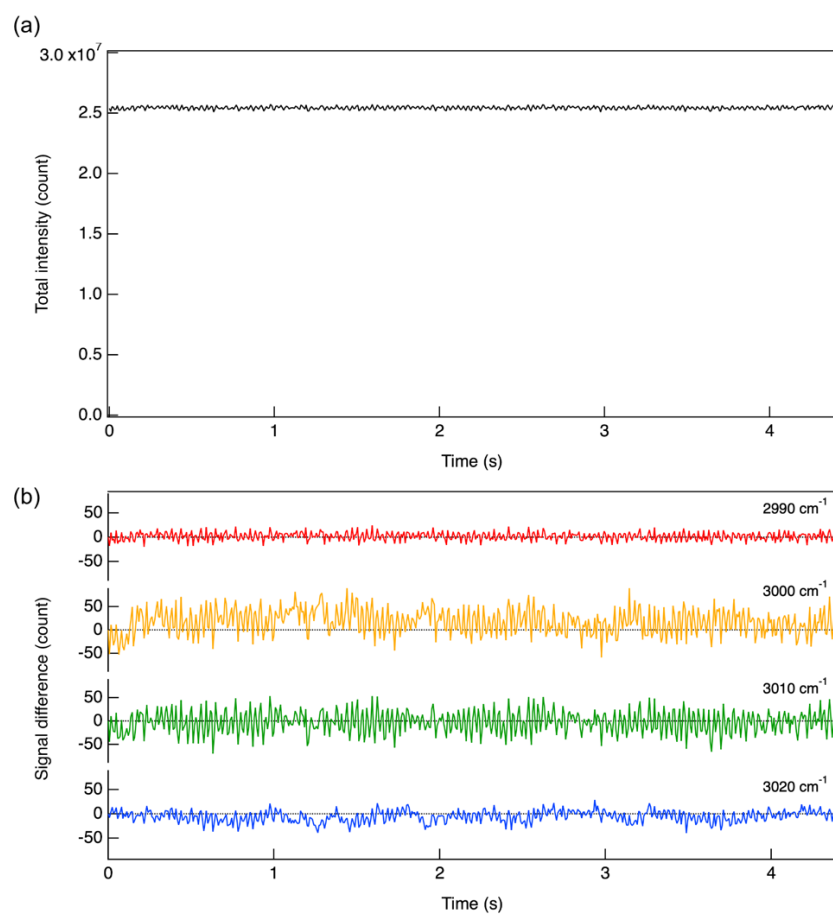


Fig. S1. (a) Total intensity of the mid-infrared light as a function of time. (b) Changes in spectral intensity for each spectral element as a function of time.

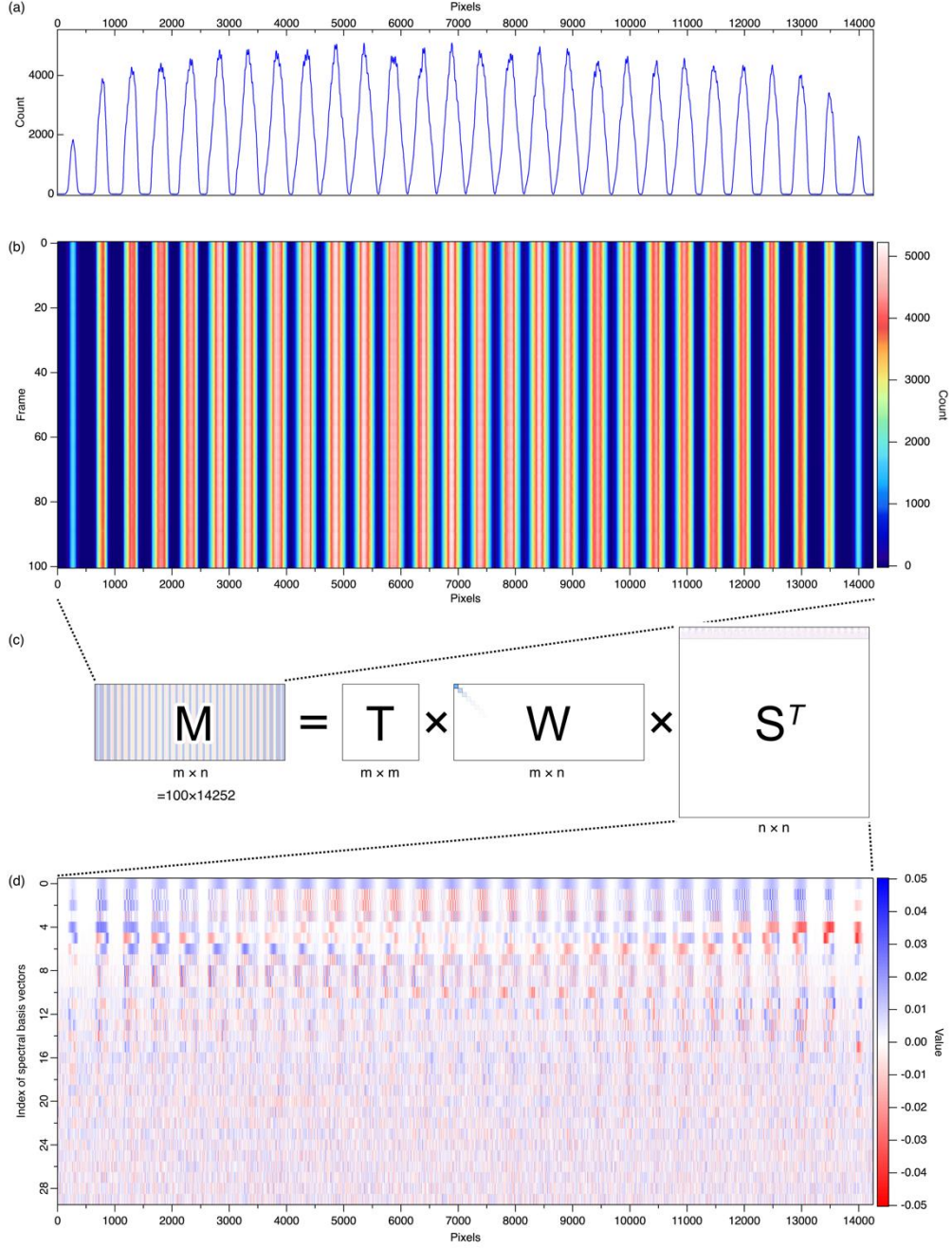


Fig. S2. (a) Concatenated spectra of the echellegram. (b) A matrix constructed by stacking 100 concatenated spectra along the time direction. (c) Singular value decomposition. See the main text for the definition of the matrices  $M$ ,  $T$ ,  $W$  and  $S$ . (d) The first 30 basis vectors of the reference spectrum.

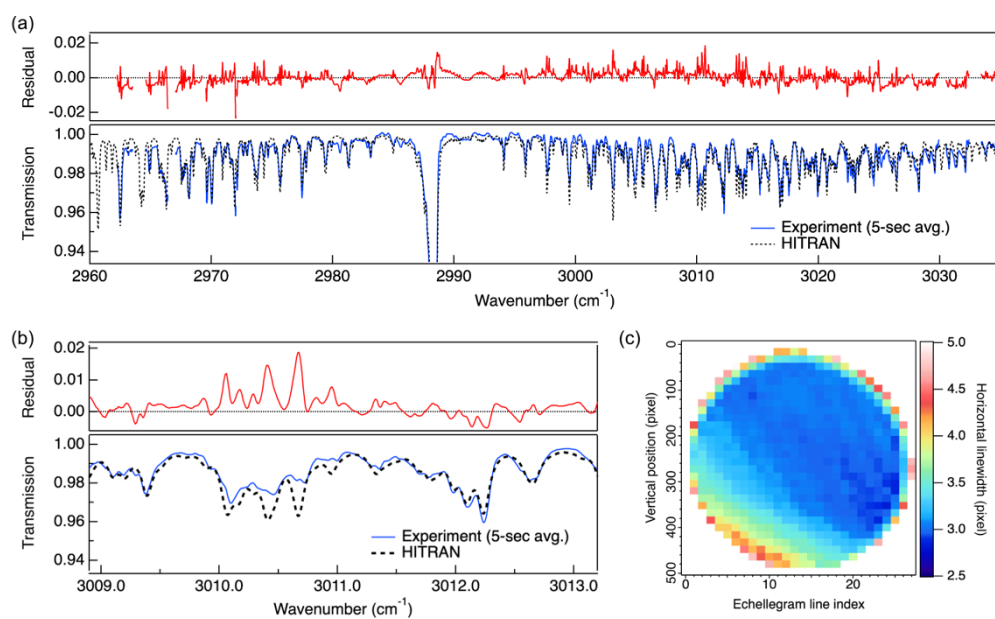


Fig. S3. (a) The differences between the measurement and HITRAN. The data was same as Fig. 2. (b) Magnified view of (a). (c) Horizontal linewidth of each diffraction order in the echellogram.

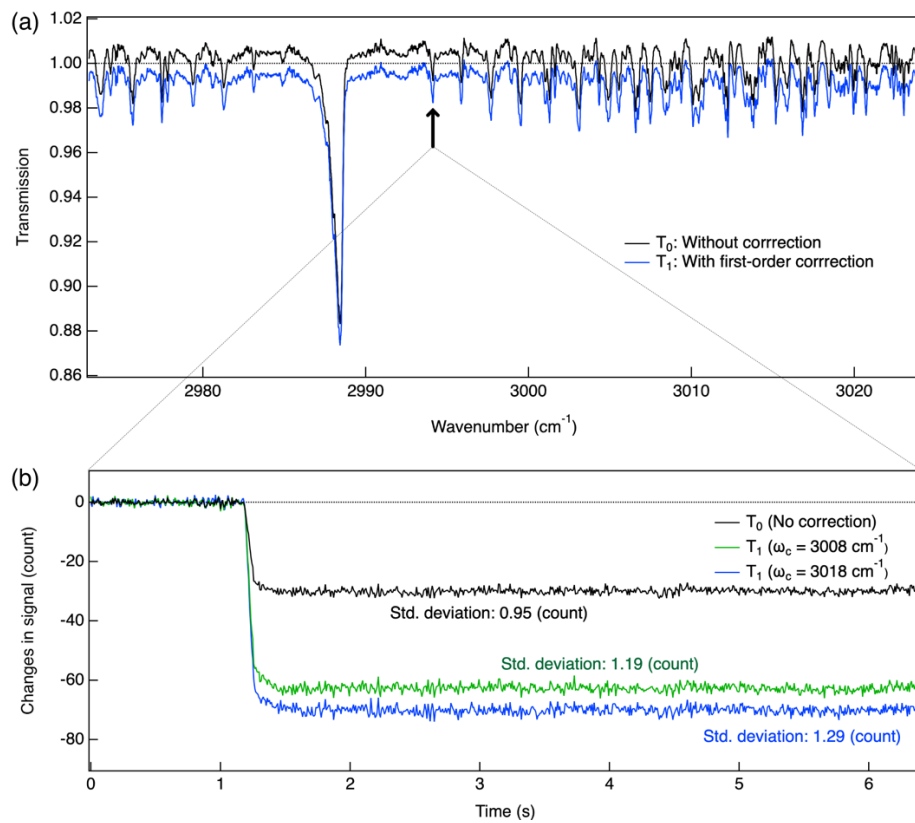


Fig. S4. (a) Transmission spectrum from a single frame using the reference spectrum estimation with and without correction. (b) Temporal changes in signal at  $2994 \text{ cm}^{-1}$  with and without correction. The experimental condition was same as Fig. 3(c)

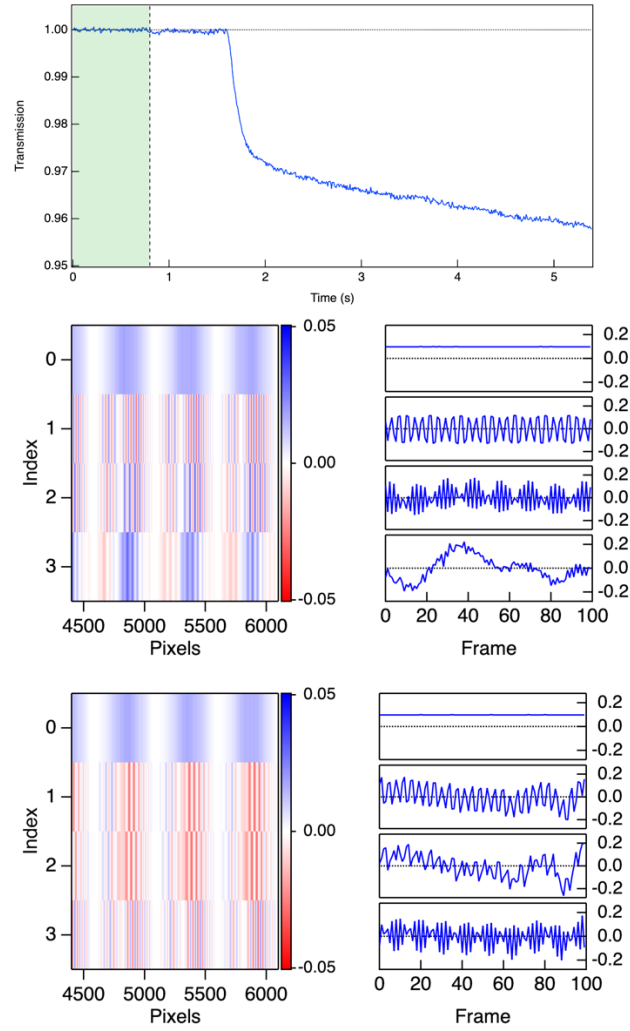


Fig. S5. (a) Temporal changes in transmission at an absorption peak of ethylene. The measurement was done 30 minutes after the measurement of Figs. 3-5. (b) First four basis vectors of spectra and time variations of the measurement (a). (c) Same as Fig. 5(a).

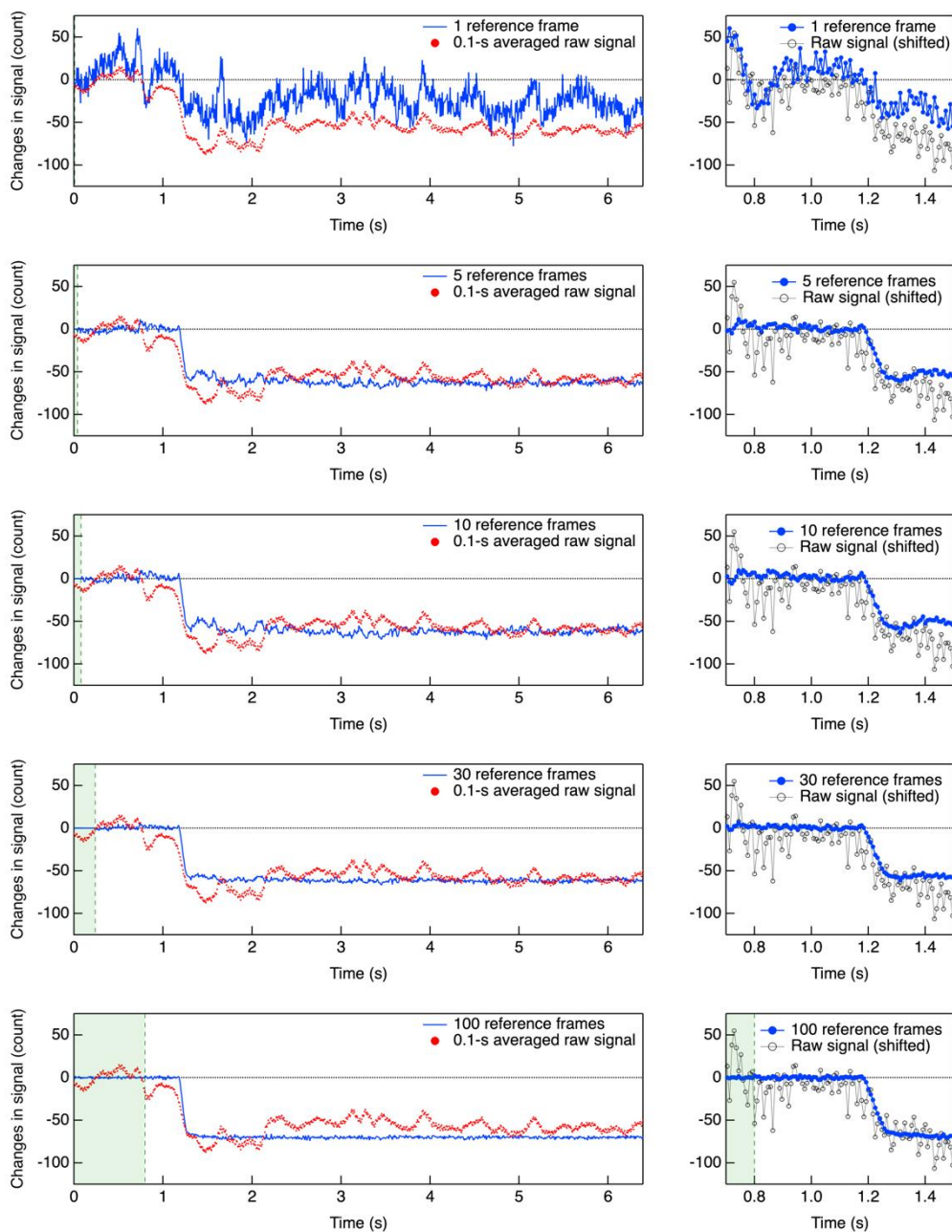


Fig. S6. Temporal changes in signal for various number of reference frames at 2994 cm<sup>-1</sup>. The conditions were same as Figs. 3(c), (d) and (e).