SYNCHROTRON FAR INFRARED SPECTROSCOPY: HIGHER RESOLUTION AND LONGER WAVELENGTHS AT THE CANADIAN LIGHT SOURCE

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In order to take full advantage of the high spectral resolution capability of the Bruker IFS125 Fourier transform spectrometer (MOPD = 9.4 m) at the Canadian Light Source far infrared beamline, we have interfaced a large 2 m gas cell which allows longer absorption paths, lower sample pressures, and hence reduced pressure broadening. We are using acrolein (CH_2CHCHO) for testing. Interesting in its own right, this molecule is also of importance in astrophysics, combustion chemistry, and human respiration (cigarette smoke, smog). Our initial CLS work[b] on ν_{12} ($\sim$564 cm^{-1}) and ν_{17} ($\sim$593 cm^{-1}) has now been extended to ν_{18} ($\sim$158 cm^{-1}), $2\nu_{18}$ ($\sim$314 cm^{-1}), ν_{13} ($\sim$323 cm^{-1}), $3\nu_{18}$ ($\sim$469 cm^{-1}), and further vibrational levels.

We experience significant gains in source intensity and signal-to-noise ratio due to the brightness advantage of synchrotron radiation compared to conventional thermal far infrared sources, though source noise (due to mechanical vibrations) remains a concern. Even greater gains at long wavelengths ($<$50 cm^{-1}) may be possible using coherent synchrotron radiation (CSR), achieved by shortening the electron bunch length in the synchrotron storage ring.[c] Initial testing of CSR at CLS has already yielded a recognizable high-resolution spectrum of N_2O pure rotational transitions in the 10 - 20 cm^{-1}range.

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[b]A.R.W. McKellar, D.W. Tokaryk, L.-H. Xu, D.R.T. Appadoo, and T. May, *J. Mol. Spectrosc.* **241**, 31 (2007).

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