COMBINATION BANDS OF THE NONPOLAR N_2O DIMER AND INFRARED SPECTRA OF $(C_2D_4)_2$ AND $(C_2D_4)_3$ USING A QUANTUM CASCADE LASER

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Our pulsed-jet supersonic apparatus has been retrofitted by an infrared cw external-cavity quantum cascade laser (QCL) manufactured by Dayligh Slutions to study infrared spectra of weakly-bound complexes. The QCL is used in the rapid-scan signal-averaging mode. Although the repetition rate of the QCL is limited by its PZT scan rate, which is 100 Hz, we describe a simple technique to increase the effective repetition rate to 625 Hz. In addition, we have significantly reduced the long term frequency drift of the QCL by locking the laser frequency to the sides of a reference line. Performance of the apparatus is illustrated by recording spectra of the combination bands of the nonpolar $(^{14}N_2O)_2$ and $(^{15}N_2O)_2$ and infrared spectra of ethylene dimer and trimer.

Spectra of ethylene dimer and trimer were studied in the ν_{11} fundamental band region of C_2D_4 ($\sim$ 2200 cm^{-1}). The dimer spectrum is that of a prolate symmetric top perpendicular band, with a distinctive appearance because the A rotational constant is almost exactly equal to six times the B constant. The analysis supports the previously determined cross-shaped dimer structure with D_{2h} symmetry. Ethylene trimer has not previously been observed with rotational resolution. The spectrum is that of an oblate symmetric top parallel band. It leads to a proposed trimer structure which is barrel shaped and has C_{3h} or C_3 symmetry, with the ethylene monomer CC axes approximately aligned along the trimer symmetry axis.