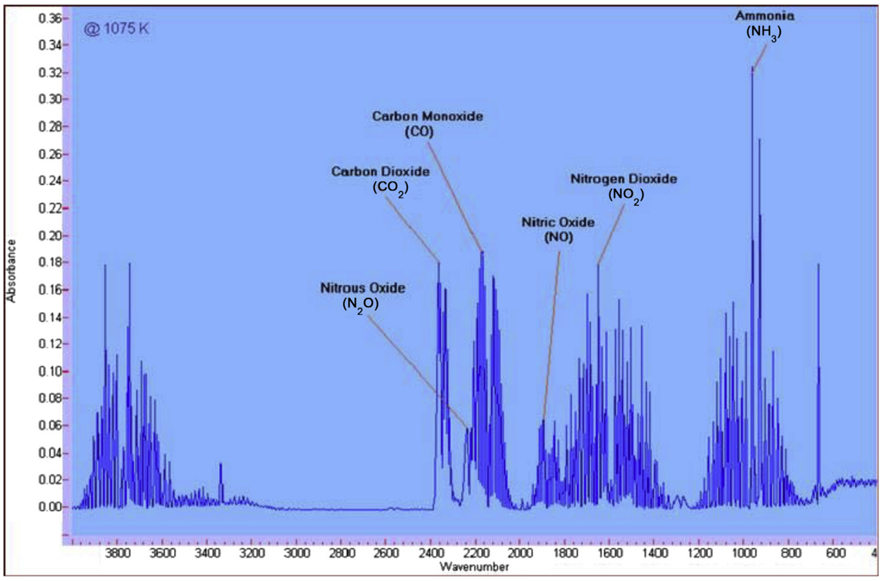

FIGURE 25.15 **Fourier transform infrared absorption spectrum recorded at 1075 K.** (For color version of this figure, the reader is referred to the online version of this book.) *Ref. 1*.

of all the ultraviolet (UV) absorbing molecules in the UV beam path are captured in the UV spectrum, and so on. When a molecule absorbs light, the energy of the molecule is increased and the molecule is promoted from its lowest energy state (ground state) to an excited state. Light energy in a specific wavelength region of the electromagnetic spectrum stimulates molecular vibrations. Molecular species display their own characteristic vibrational structure when stimulated by that specific wavelength region of radiation. Figure 25.15 provides an example of the IR absorption spectra for nitrous oxide, CO_2, CO, NO, NO_2, and NH_3. Vibrational frequency is represented by wave number, and the wave number and vibrational structure identify a particular molecule.

The open-path Fourier transform infrared (OP-FTIR) spectroscopy is quite versatile in that it is able to quantify many chemicals in air simultaneously, whereas most open-path systems must be tuned to a specific compound (Figure 25.16). OP-FTIR detects numerous compounds in the low ppb range. FTIR provides mean concentrations over designated path lengths. TDLs have similar detection limits as FTIR, but are an example of a compound-specific open-path approach, or at least are restricted to detecting chemicals that respond to the small frequency range they operate in. Like FTIR, open-path Raman spectroscopy can quantify many chemicals and may achieve low detection limits; however, its weak signal diminishes resolution. However, relative humidity is a major interference of FTIR but not for Raman, so Raman is likely preferred in high moisture conditions.[24]

The Beer−Lambert Law states that for a constant path length, the intensity of the incident, i.e. direct, light energy traversing an absorbing medium diminishes exponentially with concentration, i.e. energy absorption is proportional to chemical concentration:

$$A = eb[C] \tag{25.3}$$

where, A is the absorbency of the molecule, e is the molar absorptivity (proportionality constant for the molecule), b is the light's path length, and $[C]$ is the chemical concentration of the molecule. Thus, the concentration of the chemical can be ascertained by measuring the light

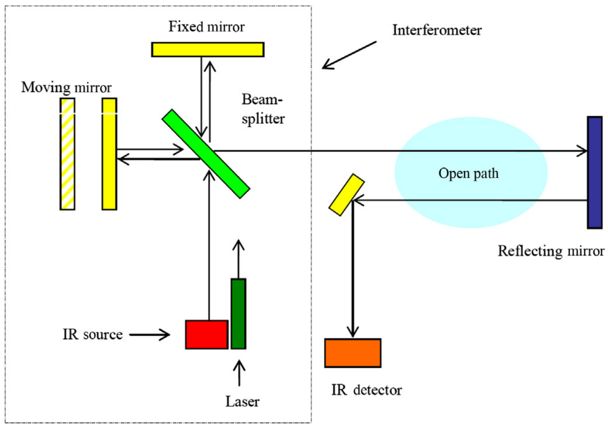

FIGURE 25.16 **Schematic of open-path Fourier transform infrared (OP-FTIR) spectroscopy system.** (For color version of this figure, the reader is referred to the online version of this book.) *Ref. 1*.