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Radiative properties at high temperature: recent developments for CO2 and CH4.

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The modeling of radiative transfer in high temperature gases is required in many industrial applications (combustion chambers, plume signature, atmospheric entries…) or space applications. The base of such modeling relies on the availability of an extensive spectroscopic database, which includes all radiative processes which contribute to emission or absorption. These databases are generally obtained by theoretical calculations. It is thus necessary to validate them experimentally, at least partially. Another difficulty associated with radiative transfer in high temperature media is the huge number of radiative transitions, which are involved. Radiative transfer calculations based on a line-by-line approach are impracticable for complex geometries of non isothermal media. It is thus necessary to develop approximate models such as band models.

We will present an overview of the studies devoted to radiative properties of CO2 and CH4 at high temperature (a few thousands Kelvin). For both molecules a spectroscopic database has been developed. Two different theoretical approaches have been used to model the IR contributions: variational calculation or effective Hamiltonian approach. Two experimental setups have been developed to partially validate the database. An isothermal high temperature cell allows recording absorption spectra up to 900 K. A microwave discharge leading to an axisymmetric plume is used to record emission spectra up to a few thousands Kelvin. Both setups are coupled to a high resolution FTIR (Bomen DA8) for infrared characterization. The emission spectra of the microwave discharge can be recorded in the near UV-visible range using a monochromator equipped with a CCD camera. Band models have been developed from the obtained database for local thermodynamic equilibrium applications. The development of band models for non-equilibrium case is presently investigated.