High temperature study of the reaction between CN and hydrocarbons using a novel high enthalpy flow tube

Saidani.Ghassen[1,*],Biennier.Ludovic[1],Georges.Robert[1],Hugo.Edouard[1], Gardez.Aline[1], J.B.Mitchell[1], Reddy.K.P.J[2], Arunan.E[3]

[1] Institut de Physique de Rennes UMR 6251 CNRS
[2] Indian Institute of Science, Aerospace Engineering
[3] Indian Institute of Science, Inorganic and Physical Chemistry Department
* Corresponding author: saidanighassen@gmail.com

The gas phase chemistry of CN radical is important in a variety of environments, ranging from astrophysics [1, 2] to NO_x formation and destruction in combustion [3]. For instance, neutral-neutral reactions of the CN radical with saturated and unsaturated hydrocarbons could be a dominant route in the generation of HCN which is an important precursor in the formation of NO. However, in spite of this importance, direct measurements of the rate constants of this species, particularly at high temperatures, are limited and, thus, deserve detailed laboratory investigation. The approach we have developed aims to bridge the temperature gap between resistively heated flow tubes [4, 5] and shock tubes [6, 7]. The present kinetic measurements are obtained using a new reactor combining a high enthalpy source with a flow tube and a pulsed laser photolysis–laser induced fluorescence (PLP-LIF) system to probe the undergoing chemical reactions. The high enthalpy flow tube has been used to measure the rate constant of the CN radical reaction with saturated and unsaturated hydrocarbons including ethane (C_2H_6) and ethylene (C_2H_4) over a temperature range extending from 300 to 1200 K. The majority of the reactions studied are rapid, with rate coefficients greater than $10^{-10}cm^3$ $molecule^{-1}$ s^{-1} which fit well the precedent experimental data [8-12] and confirm the theoretical suppositions [13].
The rotational temperature of the gas is also derived from the analysis of the LIF spectrum of CN radical using a Boltzmann plot. This procedure is systematically used to extract the rotational temperature of the gas flow for applied heating currents from 0 to 130 A. This work is concluded with an empirical estimation of the vibrational relaxation time of the excited CN radicals in their ground states to confirm the observation of two weak bonds assigned to the hot band transition.