CONSTRUCTION OF THE DISTRIBUTION FUNCTIONS OF THE OH RADICALS IN THE H₂—O₂ FLAME

J. FERDINAND

Electrotechnical Faculty, Czech Technical University, Prague

In the present paper the construction of the distribution functions for OH radicals in the H₂—O₂ flame is dealt with. The construction is based on the fact stated in [1] that there are two groups of OH radicals in the flame. It is shown here that the method for temperature determination used in [1] can be considered as the first approximation only. According to this fact the method of determining the parameters of the flame (temperature etc.) solving system of equations for line intensities is presented here. In practice it is possible under certain conditions, discussed here, to use an improved method in order to determine the flame parameters and distribution functions of OH radicals. Also the reduction of the temperatures of the cold group of OH radicals based on above mentioned improved method is discussed here. The values of the temperature of the cold group of OH radicals to be reduced are taken from [1].

INTRODUCTION

In paper [1] it was stated that in the flame two groups of OH radicals are present: the cold one and the hot one. This statement was based on the fact that the spectral characteristic \(\log I_k - \log A_k\) versus \(E_k\) (\(I_k\) is the k-th line relative intensity, \(A_k\) is the corresponding transition probability and \(E_k\) is energy of the k-th energetic level) has two straight line parts. All measurements described in [1] were carried out on the plasma of the equilibrium zone of the H₂—O₂ flame. For measurements the R₂ branch of O→O transition of the OH radicals spectrum was used.

From such a form of the spectral characteristic as discussed above we can conclude that in the flame there are two groups of OH radicals. The temperature of these groups can be evaluated in the first rough approximation from the slopes of the particular parts of the characteristic. But such evaluation is not quite correct. As it follows from the results of the paper of MEINEL and KRAUSS [2] and the papers of MEINEL [3, 4], we must consider the fact that both these groups are not independent. The consequences following from this fact shall be discussed later.

Now we turn our attention to the result of the measurement of the line intensities of R₂ branch of OH radicals spectrum. If we plot the intensity of the k-th line versus rotational quantum number \(K\), we obtain the dependence shown in Fig. 1. This dependence is based on results of paper [1]. Parameters of the flame (flow rates etc.) are indicated in Fig. 1.

Discussing the details of this dependence we must first consider that the intensity of R₂ 13 line is weaker than it was expected. This fact can be accounted for by the

*) Suchbátarova 2, 166 27 Praha 6, Czechoslovakia.
influence of the background of R₂ 13 line. This line is situated in the great complex of lines and this fact due to small resolving power of the spectrograph (the spectrograph used was Zeiss ultraviolet spectrograph Q 24) which is responsible for the small distance between lines of this complex on the spectrogram, make it not possible to measure the exact value of the background of R₂ 13 line. Secondly we must consider that the intensity of R₂ 16 line is greater than it was expected. This fact can be explained by the existence of the third group of OH radicals with extremely high temperature. Second possible explanation is that the value of intensity of the R₂ 16 line is greater in consequence of some chemoluminescent reaction. Both explanations are possible; more detailed discussion of that problem is out of the scope of this paper.

Now we shall discuss the main character of the spectral dependence presented in Fig. 1. We can determine two maxima of this dependence. So it is clear that this dependence, which represents the distribution function for OH radicals, we can construct as a sum of two distribution functions. It must be stated here, that the distribution presented in Fig. 1 was normalized to 10. But there is one difficulty in such construction. The distribution functions forming the final (measured) distribution are not known. Further difficulty is, that we cannot measure the intensities of all lines with the rotational quantum number in the range 1−20. This difficulty will be discussed later.

The lack of knowledge of the single distribution functions forming the final distribution has a very substantial consequence. The temperatures of the single groups of OH radicals must be evaluated from these two components of the final distribution function. But we stated above that these distributions are not known and from this fact it follows that the exact values of the temperature are not known a priori. This is the basis of papers [2−4]. In these papers the authors used a very difficult