TRANSITION PROBABILITIES OF SOME UV Kr II SPECTRAL LINES

M. T. Belmonte[1], L. Gavanski[2], R. J. Peláez[3], J. A. Aparicio[1], S. Djurović[2] and S. Mar[1]

[1]Universidad de Valladolid, Departamento de Física Teórica, Atómica y Óptica, Paseo de Belén 7, E-47011 Valladolid, Spain
[2]University of Novi Sad, Faculty of Sciences, Department of Physics, Trg Dositeja Obradovića 4, 21000 Novi Sad, Serbia
[3]LaserProcessing Group, Instituto de Óptica, CSIC, Serrano 121, E-28006 Madrid, Spain

Abstract. Experimentally obtained transition probabilities for some ultraviolet Kr II lines, expressed in absolute units, are presented in this paper. For the measurement, intensities of spectral lines emitted by a plasma generated in a low-pressure pulsed arc were used. The electron density was in the range of (1.5 - 3.4) × 10^{22} m^{-3}, while the temperature was between 28 000 K and 35 000 K.

1. INTRODUCTION

In this paper, we report experimental results of transition probabilities for some UV lines of singly ionized krypton. Transition probability data, for a number of Kr II spectral lines from the UV spectral region, have been published recently in [1]. Here we give an extension of those measurements. These data are of interest for plasma diagnostic purposes, especially for the determination of the plasma temperature using a method based on spectral line intensities [2]. These data are also important for the development of light and laser sources [3, 4] as well as in astrophysics [5-7].

The absolute values of the transition probability data were obtained by measuring the relative spectral line intensities. Seven spectral lines with well known transition probability data were used to transform our relative measurements into absolute ones.

2. EXPERIMENT

As the plasma source, we used a low pressure pulsed arc. It was a Pyrex glass tube, 175 mm long and 19 mm in internal diameter. The pulses were made by discharging a 20 μF capacitor bank, charged up to 7.8 kV. The plasma life was about 200 μs. Pure krypton was continuously flowing through the discharge tube under a pressure of 120 Pa.

The spectra were recorded by using a 1.5 m spectrometer equipped with a 2400 lines/mm grating. At the exit of the spectrometer, an ICCD camera was mounted. The spectra were observed along the discharge tube, 2 mm off the tube axis at the instants 50, 60, 100 and 110 μs after the beginning of the discharge. The exposure time ranged between 2 and 5 μs. Every line profile was checked for the presence of the self-absorption effect.

The electron density, in the range of (1.5 - 3.4) $\times$ 10^{22} m^{-3}, was measured by a two-wavelength interferometric technique, using two He-Ne lasers radiating at 543.5 nm and 632.8 nm. The laser beams passed 2 mm off the tube axis, opposite to the optical measurements. The axial homogeneity of the plasma and the cylindrical symmetry enabled simultaneous optical and interferometric measurements. The estimated error for the electron density determination is about 5%. The electron temperature was obtained by using the Boltzmann plot technique. According to [8], the plasma was in PLTE. For this purpose, we used seven Kr II lines (459.280, 460.402, 461.529, 461.917, 482.519, 483.208 and 484.661 nm) with well known transition probabilities [9, 10]. The temperature was between 28000 and 35000 K. The estimated errors were lower than 10%.

3. RESULTS

The results are shown in Table 1. The first column contains the transitions, while in the second column the corresponding wavelengths are given. The Table is arranged in order of increasing wavelength. The wavelength and transition data are taken from the NIST Atomic Spectra Database [9], except for

Table 1. Measured transition probability data for some UV Kr II spectral lines.

Transition	Wavelength (nm)	A_{ki} (10^8 s^{-1})	Exp. error
$(^1D)5s\ ^2D_{5/2} - (^3P_1)4f\ ^2[3]°_{7/2}$	220.840	0.019	18%
$(^3P)4d\ ^4D_{5/2} - (^3P)6p\ ^4D°_{7/2}$	224.531	0.080	7%
$4d\ ^4F_{3/2} - 5f'\ ^2F°_{5/2}$	230.267	0.084	18%
$4d\quad - (^3P_1)4f\ ^2[3]°_{5/2}$	248.750	0.313	18%
$(^3P)5p\ ^2D°_{5/2} - (^1D)5d\ ^2P_{3/2}$	266.122	0.189	18%
$(^3P)4d\ ^2P_{3/2} - (^1S)5p\ ^2P°_{1/2}$	271.027	0.065	18%
$4d\quad - (^3P_1)4f\ ^2[3]°_{7/2}$	277.459	0.042	18%
$(^3P)5p\ ^4S°_{3/2} - (^1D)5d\ ^2F_{5/2}$	277.796	0.137	18%
$(^3P)4d\ ^4P_{5/2} - (^3P)6p\ ^4D°_{7/2}$	312.602	0.022	25%

the 230.267 nm line, for which there are no data in this Database. For this line, we used transition notation from Striganov and Sventitskii Tables [11]. The third column contains the measured transition probabilities in absolute units. In the last column the estimated experimental errors are presented. As the reference lines, employed to transform relative transition probabilities into absolute units, we used the same lines that we had used for the temperature determination.

Examples of spectra with some of the considered lines are given in Figs. 1 and 2. Even if the lines 248.750 nm and 248.762 nm were blended, we were able to separate and fit their profiles as shown in Fig. 1.

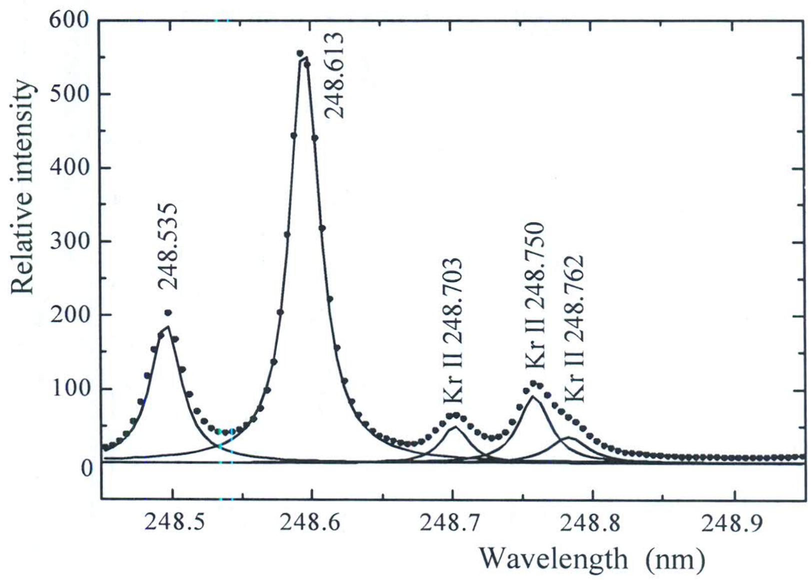

Figure 1. Part of the ionized krypton spectrum close to the 248.750 nm line.

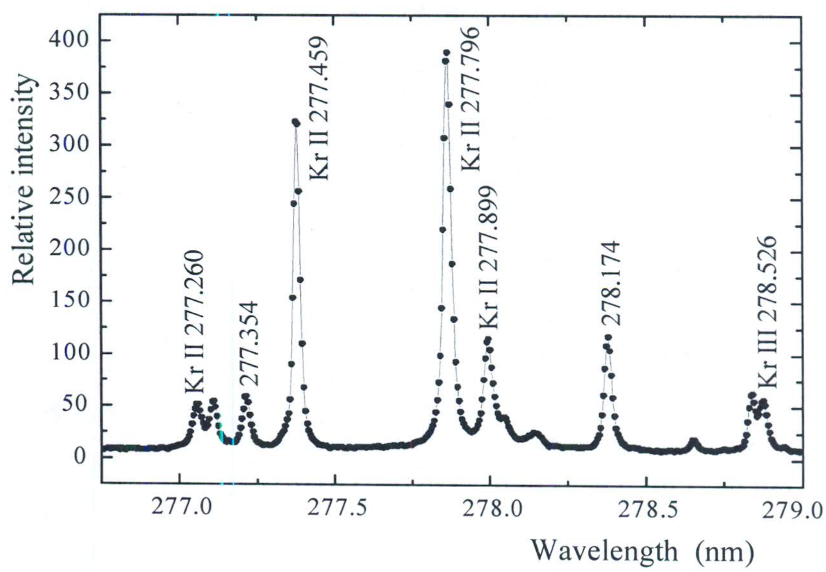

Figure 2. Part of the ionized krypton spectrum close to the 277.459 nm and 277.796 nm spectral lines.

There are no transition probability data in the literature for the considered lines and the present data are given here for the first time.

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