SOME PROCESSES IN VACUUM-ULTRAVIOLET IRRADIATED Xe

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It is known that irradiation of Xe in the vacuum-ultraviolet results in various emissions in the same region [1]: the first and the second continua, the 130 nm molecular bands, and the atomic resonances at 147 and 119.2 nm. On the other hand excitation of Xe by electrons has been reported [2] to yield also a large number of lines due to the decaying of some Xe upper Rydberg states of 6p,6p' and 7p configuration. We have irradiated Xe in the .5-200 torr pressure range by a vuv source in order to detect emissions in the near ir region.

This study has been carried out using an electrical discharge hydrogen lamp as a source, a 0.3 m Czerny-Turner monochromator for the fluorescenze spectra, a 1 m vuv monochromator for the excitation fluorescence spectra, and thermoelectrically couled photomultipliers (extended S-20 and 119 spectral response).

In fig. 1 the emission spectrum obtained is shown. It consists of three lines wich have been assigned[3] to the following atomic transitions:

$$6p(1/2)_0 \longrightarrow 6s(3/2)_1 + h\nu \ (828.01 \text{ nm}) \qquad 1)$$

$$6p(3/2)_2 \longrightarrow 6s(3/2)_2 + h\nu \ (823.16 \text{ nm}) \qquad 2)$$

$$6p(5/2)_3 \longrightarrow 6s(3/2)_2 + h\nu \ (881.94 \text{ nm}) \qquad 3)$$

The third emission is very weak and the intensity of the first process relative to the second increases with pressure. At low pressure the ratio is close to unit as espected on the basis of the A values [4] or the intensities given in the literature [3].

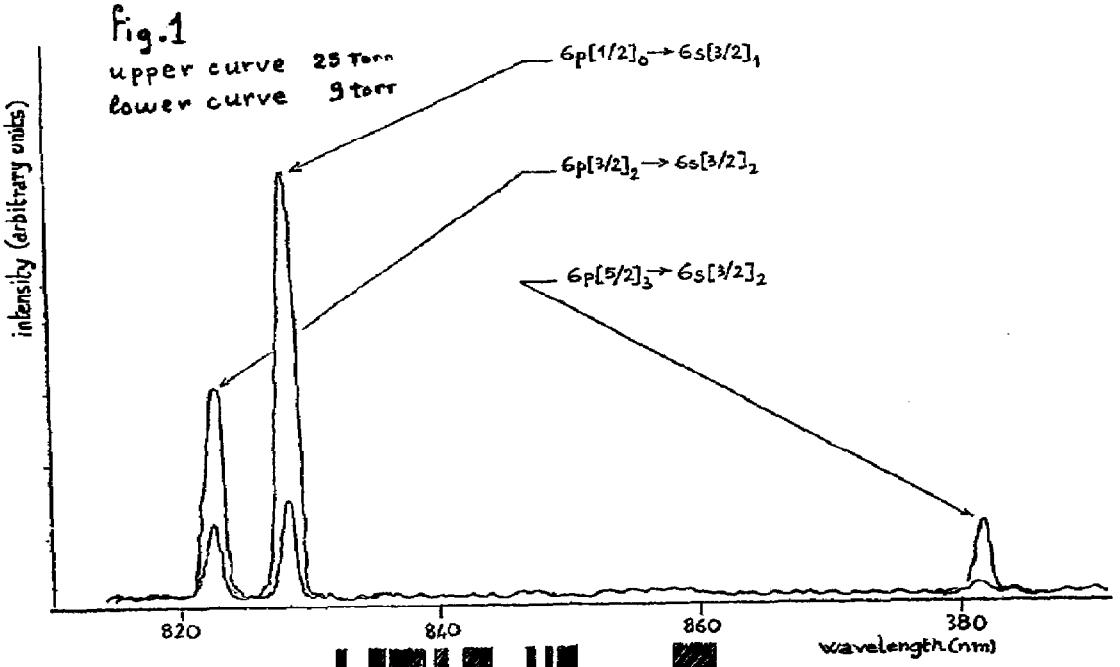
Fig.1
upper curve 25 Torr
lower curve 9 torr
6p[1/2]0 → 6s[3/2]1
6p[3/2]2 → 6s[3/2]2
6p[5/2]3 → 6s[3/2]2
intensity (arbitrary units)
820
840
860
380
wavelength (nm)

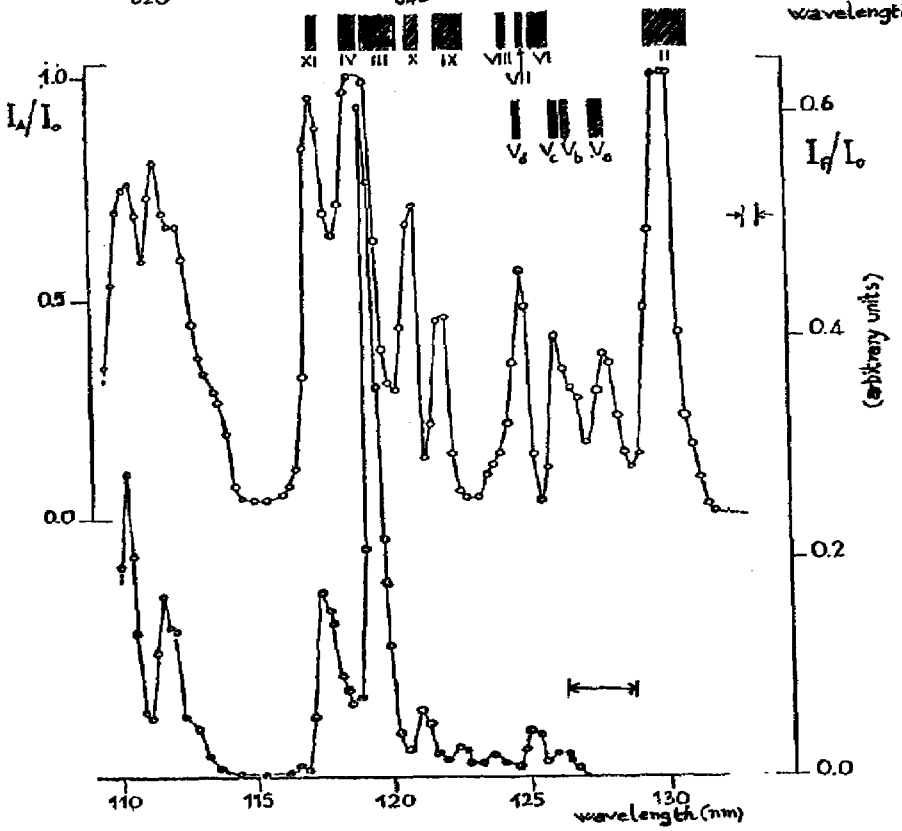
XI IV III X IX VIII VII VI II
Vd Vc Vb Va
I_A/I_o
I_f/I_o
1.0
0.5
0.0
0.6
0.4
0.2
0.0
(arbitrary units)
110
115
120
125
130
wavelength (nm)

Fig. 2

Within a factor of fifty no other lines were present in the 380 900 nm range.

In fig.2 the excitation spectrum of the unresolved emissions is reported at 10 torr (lower curve) and can be compared with the absorption curve at 100 torr (upper curve). The molecular absorption regions, classified by M.C. Castex [5] are also indicated. The energy threshold $h\nu_0$ is a function of the Xe pressure in the gas cell. At 1 torr $h\nu_o$ is 126,2 $\pm$ 2 nm and coincides with the excitation energy of the process Xe ($6p(3/2)_2 \longleftarrow 5p^6$). At 150 torr $h\nu_o$ is 128.2 $\pm$ 2 nm. Assuming a molecular type of absorption in the region below the low pressure threshold, the shift can be accounted for by the relative translational energy in the Boltzmann factor wich gives a concentration of the absorbing pairs $(p/p_o)^2$ fold the value at p_o. The structure of the bands in the fluorescence excitation spectrum follows rather closely the structure of the absorption bands described in the literature [5].

The pressure dependence of the unresolved emissions has been studied at various wavelenghts and compared with that of the absorbing processes. The difference in the pressure dependence of the two processes appears to be minor and a kinetic mechanism can be outlined. This attributes the occurrence of processes 1) and 2) mostly to the dissociation or predissociation of molecular states or to a few atomic processes connecting some upper states to the levels responsible of the detected emissions.

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3)A.R.Striganof, N.S.Sventitskii,Tables Spec. Lines (1968).
4)M.H.Miller,R.A.Roig,R.D.Bengston,Phys Rev.,A8,480 (1973).
5)M.C.Castex, Chem. Physics, 5 448 (1974).