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THE OBSERVATION OF CADMIUM ATOMS IN THE STATE OF 5 $^3P_0$

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The 5 $^3P_0$ state of cadmium atoms produced in the Cd-photosensitized reactions of Ar, N_2, and NH_3 has been observed by the absorption at the wavelengths of 340.4 nm (5 $^3D_1$ — 5 $^3P_0$) and 467.8 nm (6 $^3S_1$ — 5 $^3P_0$). The pressure dependence is displayed.

In the cadmium-photosensitized reactions, the participation of the 5 $^3P_0$ state has not been ascertained yet, although Morten et al. assumed the $^3P_0$ state as the precursor of the emitting species in the cadmium-photosensitized emission of ammonia.[1,2] On the other hand, the 6 $^3P_0$ state of mercury atoms was studied by several groups,[3~7] and now, it is well known that the $^3P_0$ state is easily produced in the 2537 A mercury-photosensitization in N_2 or CO.

In order to observe the 5 $^3P_0$ state of cadmium atoms, we constructed an apparatus, which is schematically illustrated in Fig. 1. This apparatus is almost the same as that reported in a previous paper[2] except for the light source for the measurement of absorption.

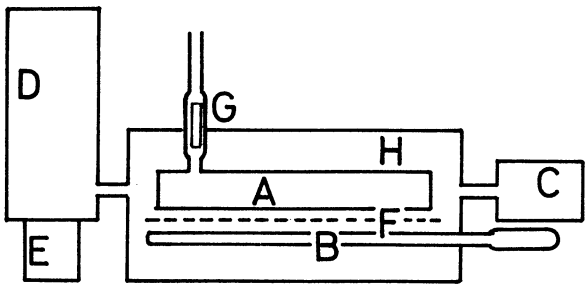

Fig. 1. The apparatus for the measurement of the absorption. A: reaction vessel, B: exciting resonance lamp, C: light source for the measurement of absorption, D: monochromator, Shimazu QV-50, E: photomultiplier 1P28, F: shutter, G: stopper for cadmium vapor, H: furnace at 250 °C.

The absorption of the cadmium ($^3P_0$) atoms were observed at the two wavelengths of 340.4 nm (5 $^3D_1$ — 5 $^3P_0$) and 467.8 nm (6 $^3S_1$ — 5 $^3P_0$). The relative values well coincided with each other, as shown in Fig. 2. The slit of the

monochromator was properly opened to avoid the loss due to the pressure broadening of the absorption of the measuring spectral lines. The relative values shown in Fig. 2, therefore, are roughly proportional to the stationary concentration of the cadmium ($^3P_0$) atoms, although care has to be paid to the pressure dependence of the extinction coefficients.[5)]

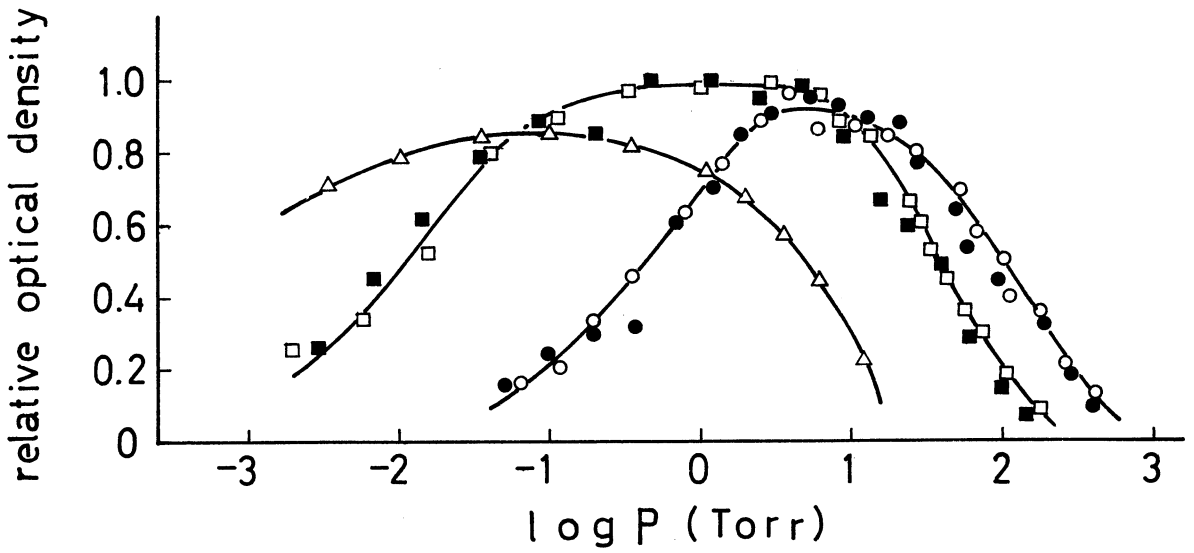

Fig. 2. The pressure dependence of the stationary concentration of Cd ($^3P_0$) atoms. Absolute optical density at 1 Torr of N_2 is about 0.1. o,●: Ar, □,■: N_2, Δ: NH_3. Open signs were obtained at 340.4 nm and shaded signs at 467.8 nm.

The formation of the 6 $^3P_0$ state of mercury in N_2 and CO has been explained by the closeness of the energy difference between $E(^3P_1) - E(^3P_0) = 5.0$ kcal/mol and vibrational quanta, 6.7 and 6.1 kcal/mol, respectively, for N_2 and CO. However, as Fig. 2 shows, the 5 $^3P_0$ state of cadmium atoms can be produced even in Ar as well as in N_2. Although the reason is not fully understood, this may be due to the smallness in the energy difference between 5 $^3P_1$ and 5 $^3P_0$ states of cadmium atoms, which is only 1.6 kcal/ mol.

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