TIME RESOLVED STUDY OF THE UV CONTINUUM OF XENON*

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The time resolved dependences of xenon fluorescence in the ultraviolet region were observed. The formation rate constant $k_2 = 1.65 \cdot 10^{-9} \text{ cm}^6 \cdot \text{s}^{-1}$, as well as the lifetime of $\text{Xe}_2^{**}$ excimers equal to 8.1 ns have been found in agreement with earlier reports. The present evaluation, however, gave the lifetime of the $\text{Xe}_2^{**}$ precursors $\tau_0 = 100-200 \text{ ns}$, i.e. much shorter than reported by MILLET et al.

Introduction

Since the discovery of the rare gas-halogen exciplexes, a great number of papers have been published on the mechanism and kinetics of their formation. Not many of those papers, however, have provided direct observations of time-resolved formation-decay dependences. Moreover, most of the published reports concerned only the interactions of the lowest excited levels of the rare gas atoms with halogen donors. While as follows from earlier works$^{1,2}$ the higher (np) levels participate in (and enhance the effectiveness) $\text{RX}^*$ formation. The kinetics, however, is different. Additionally, in xenon for example the p levels lead to formation of $\text{Xe}_2^{**}$, which fluoresce in the same region as $\text{XeCl}^*$ (B–X) excimers (220–400 nm and 290–315 nm, respectively). So, before $\text{XeCl}^*$ fluorescence can be studied the precise formation-decay kinetics of $\text{Xe}_2^{**}$ must be known.

In the present work we provide the results of time-resolved studies on nanosecond electron beam interaction with pure xenon by observation of fluorescence in the ultraviolet region (220–400 nm). These results are compared with the earlier ones obtained by MILLET et al.$^3$ when $\alpha$-particles were used as the radiation source.

Experimental and results

An ELU-6 electron accelerator of Institute of Applied Radiation Chemistry at Lodz was used in this study. The machine emitted 7 ns pulses. The maximum energy of electrons was equal to 8 MeV and the peak current was 10 A.

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Samples were irradiated in a $T$ shape stainless steel cell through an aluminium window of 1 mm thickness. The electron beam intensity was reduced by introducing a brass plate (of 2 or 3 mm thickness) into the path of electron beam.

Light emitted from the irradiated xenon was observed through a suprasil window at right angle to the electron beam path and focussed by lenses onto the slits of a Bausch-Lomb monochromator. After amplification by a Hamamatsu R928 photomultiplier, the signal was displayed on a Tektronix 7834 storage oscilloscope and photographed. The other details of the experimental set-up are given in Ref. 5. The emission was monitored at two wavelengths, i.e. 270 nm and 308 nm. The gas pressure was varied from 40 to the 120 Torr, i.e. to the limit of pressure where the quenching processes still can be neglected. The shape of typical signals is shown in Fig. 1.

As is seen, the emission (in every case) lasted much longer than it would follow from the known lifetime of Xe$_2$ excimers (8.2 ns), which suggests that the formation rate is much slower than the decay rate, i.e. the observed decay of Xe$_2$ reflects, as a matter of fact the formation rate only.

**Discussion**

The observed UV emission spectrum of pure xenon with a maximum intensity at 270 nm was identical to that reported by MILLET et al. As is shown in Fig. 1, the time-resolved dependences are almost identical for both monitored wavelengths and