DETERMINATION OF THE RATE CONSTANT FOR THE THIRD-ORDER RECOMBINATION REACTION OF ATOMIC FLUORINE.

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ABSTRACT

The temperature dependence of the rate constant for the third-order recombination reaction of atomic fluorine on F_2 molecules has been obtained from analysis of the experimental data: $K_r = 7.0 \cdot 10^{-32}/T(^0K)$, sm^6/sec.

Processes involving atomic fluorine have been theoretically investigated. The reaction system for which the experimental data used in the calculation were obtained (I), consisted of a metal heater-catalyzer where heterogeneous dissociation of F_2 molecules occured and a cooled surface with Kr sputtered onto it. The space between the heater and the cooled surface was filled with fluorine.

Analysis of these processes revealed that actually all the space between the metal heater and the cooled Kr -covered surface might be divided into two main parts: a diffusion area where contribution from the atomic fluorine recombination to the overall physical picture can be neglected and a recombination area where the process of the third-order recombination reaction $F + F + M \rightarrow F_2 + M$ plays a great role. The dimension of the recombination area is determined substantially by the gas pressure in the system. At pressures of 20-30 torr being of interest this value does not exceed I% of the characteristic dimension of the system.

Taking the above into account the distribution of atomic fluorine in the system as well as the coefficient of penetration of fluorine atoms into the Kr matrix being of $3{,}3 \cdot 10^{-4}$ were obtained.

From the calculation made in terms of the model presented the temperature dependence of the third-order recombination reaction of atomic fluorine on F_2 molecules was obtained:

$$K_r = 7.0 \cdot 10^{-32}/T(^0K), \quad sm^6/sec.$$

REFERENCE

(I) V.N.Bezmel'nitsyn, V.A.Legasov, L.A.Palkina, B.M.Smirnov, B.B.Chaivanov, "Catalitic generation of atomic fluorine" (Preprint N 2804, Kurchatov Institute of Atomic Energy, Moscow, I977).