4.11 RESONANT ION PAIR FORMATION IN ELECTRON COLLISIONS WITH NO^+

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Last year we made the first measurements of resonant ion pair (RIP) formation for ground-state diatomic molecular ions: HD^+, HF^+, and OH^+ [1]. The RIP process involves electron capture by the ion into doubly excited neutral molecule states, followed by dissociation into an ion pair, i.e., $e + AB^+ \rightarrow AB^{**} \rightarrow A^+ + B^- + KER$, where KER is the kinetic energy release. Thus, RIP represents one channel for stabilization of the doubly excited states, other channels being dissociative recombination (DR) and resonant dissociative excitation (RDE).

To gain further insight to the RIP process, we extended our investigation to the RIP of NO^+ in the energy range 8 # E # 16 eV. Our measurements on CRYRING were carried out by detecting O^-, the only possible negative ion resulting from the RIP of NO^+.

Preliminary reduction of the data (see Fig. 1) suggests that the appearance of O^- from RIP of NO^+ occurs at a slightly lower energy (10 eV) than the expected threshold energy of 10.3 eV, ($E_t = D_0$ - EA(O) = 11.76 - 1.46 = 10.3 eV). The RIP cross section for NO^+ consists of 2 parts, a broad structure centered at about 11.8 eV and a sharp peak at 12.5 eV. At the sharp peak, the magnitude of the cross section is about 8.5×10^{-19} cm^2. As alluded to earlier, RIP, DR, and RDE involve stabilization of the same excited state NO^{**}, one expects that some correlations should exist between the cross sections for these processes. And indeed, similar to the RIP

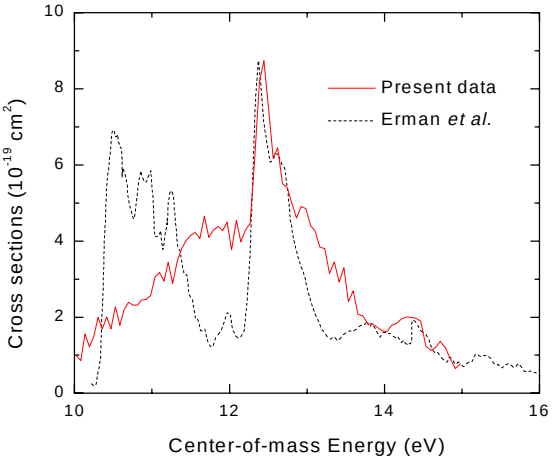

Fig. 1. Resonant Ion Pair formation cross sections and photoionization cross sections of NO^+

cross section, previously measured cross sections for both DR and RDE of NO^+ [2] show enhancement in the energy region 10-16 eV. However, the magnitude of the RIP cross section is only a few percent of the total DR cross section (3×10^{-17} cm^2) and the total RDE cross section (4×10^{-17} cm^2, sum of the DE cross sections for: $N^+ + O$ and $N + O^+$ channels) in the same energy interval.

Ion pair formation by the decay of NO^{**} excited by methods other than electron impact on NO^+ has been studied in the past. The examples include

photodissociation studies of neutral NO [3], and via electron impact studies of neutral NO [4]. Comparison of our absolute RIP cross section with the relative O^- signal intensity obtained in photodissociation studies [3] shows some similarity. The sharp peak in the RIP cross section at 12.5 eV is also seen in the photodissociation studies. However, rather than a broad structure centered at 11.8 eV as observed in the RIP cross section, the photodissociation data show a narrower, more intense 4 peaks in the energy interval 10.2 - 11.5 eV. Comparison with the electron impact studies of neutral NO [4] is difficult since those studies involve both excitation to NO^{**} and dissociative attachment to states yielding $N^* + O^-$.

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