N (^{2}P) Production in electron-N_2 Collisions.

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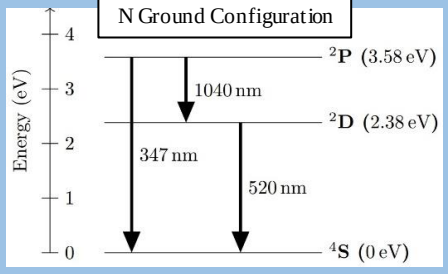
Introduction.

Previously, we have studied the production of metastable atoms and molecules using a selectively sensitive detector developed in our laboratory [1-4]. The detector consists of a cryogenically cooled surface on which a rare gas is continuously deposited forming a solid layer. A pulsed magnetically collimated, electron beam impacts the target gas, and the resulting neutral fragments drift towards the detector. The metastable species form excimers with, or transfer excitation to, the matrix which quickly radiates and the resultant photons pass through a 10 nm bandpass filter centered on 340 nm and are detected by a cooled photomultiplier. (This filter also transmits the N_2 $C^3\Pi_u - B^3\Pi_g$ (0,0) 337 nm Second Positive band) The processes may be represented by:

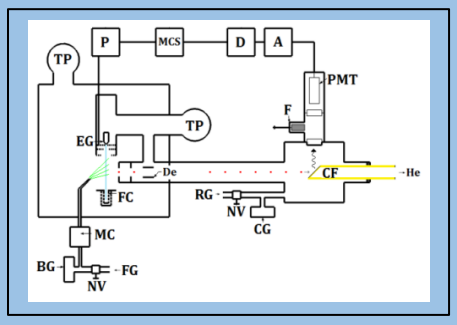
$$e + N_2 \rightarrow N(^2P) + N + e'$$

$$N(^2P) + Xe(Matrix) \rightarrow Xe[N(^2P)]^* \rightarrow h\upsilon(347\ nm)$$

Time-of-flight (TOF) spectra are obtained using a multichannel scaler, where the zero of time scale is indicated by a prompt photon peak produced from the excitation of target molecules. In the present work production of metastable N(^{2}P) atoms has been investigated using a solid xenon matrix at a temperature of approximately 15K



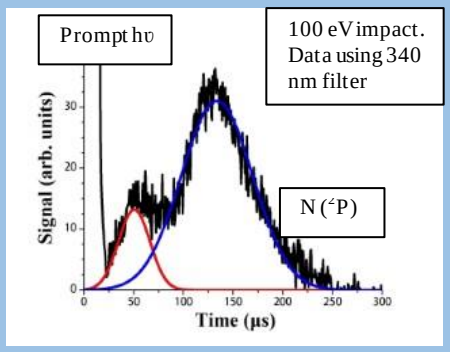
Apparatus



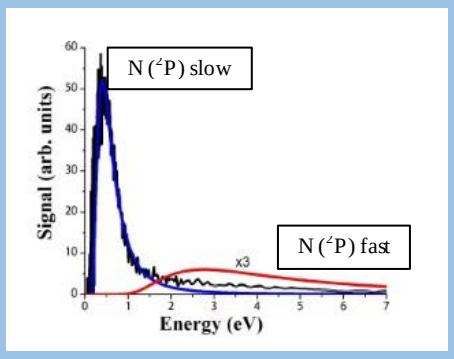
References:

1. McConkey and Kedzierski, AdvAt Mol Opt Phys, 63, 1, (2014).
2. Kedzierski et al, J Phys B, 43, 085204, (2010)
3. Kedzierski et al, Chem Phys Lett, 498, 38, (2010)
4. Kedzierski and McConkey, J Chem Phys, 145, 044313, (2016)
5. P C Cosby, J Chem Phys, 98, 9544, (1993).
6. J M Ajello et al, Phys Rev A, 40, 3524, (1989).

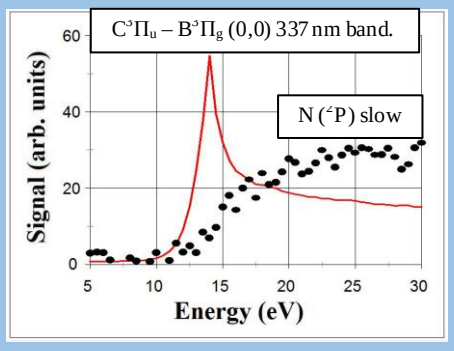
Time of Flight Data for N(^{2}P)

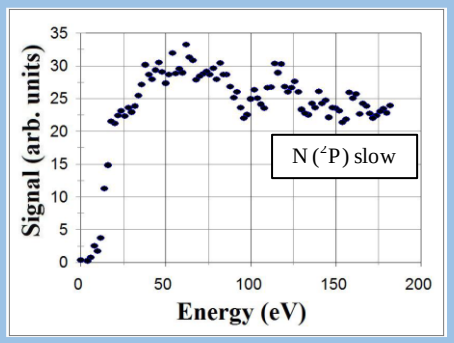


Released Kinetic Energy



Excitation Function Data.



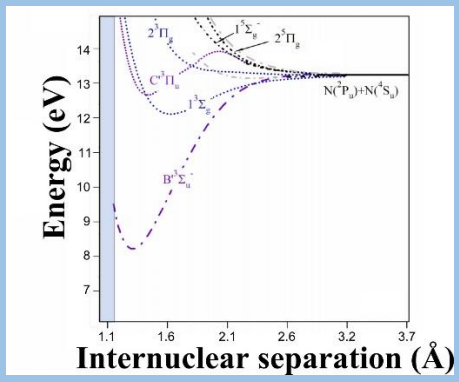


Suggested Mechanisms:

Direct Excitation:

$$e + N_2(X\,^1\Sigma_g^+, v=0) \rightarrow e' + N_2^*(B'\,^3\Sigma_u^-) \rightarrow N(^2P) + N(^4S) \quad (1)$$

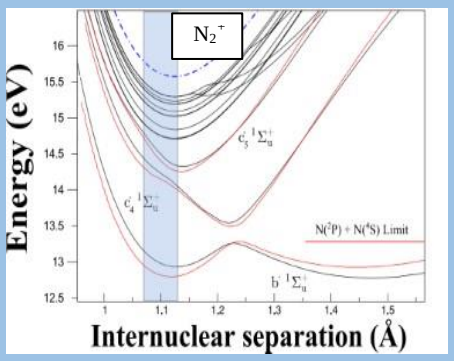
$$e + N_2(X\,^1\Sigma_g^+, v=0) \rightarrow e' + N_2^*(C'\,^3\Pi_u) \rightarrow N(^2P) + N(^4S) \quad (2)$$



Curves: **Hochlaf et al, J Phys B, 43, 245101, (2010).** Franck-Condon region is shown shaded.

Pre-Dissociation Mechanism:

$$e + N_2(X\,^1\Sigma_g^+, v=0) \rightarrow e' + N_2^*(b'\,^1\Sigma_u^+, v) \rightarrow N(^2P) + N(^4S) \quad (3)$$



Curves: **Little and Tennyson, J Phys B, 46, 145102, (2013).** Franck-Condon region is shown shaded.

Pre-dissociation of high lying states of N_2 is well known and has been extensively studied [e.g. 5, 6]. The b' state is reckoned to be 84% pre-dissociated [6]

The shape of the excitation probability curves suggest a combination of triplet and singlet parent states.

Acknowledgements: Funding for this work was provided by NSERC and CFI, Canada. Invaluable technical assistance was provided by the Physics Department Mechanical and Electronic Workshops