

# REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 30-May-2001	3. REPORT TYPE AND DATES COVERED Final Report	
4. TITLE AND SUBTITLE Characterization of Boron Atom Aggregation			5. FUNDING NUMBERS F61775-00-WE073	
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institut fur Physikalische Chemie Klingelbergstrasse 80 CH-4056 Basel Switzerland			8. PERFORMING ORGANIZATION REPORT NUMBER N/A	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) EOARD PSC 802 BOX 14 FPO 09499-0200			10. SPONSORING/MONITORING AGENCY REPORT NUMBER SPC 00-4073	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words)  This report results from a contract tasking Institut fur Physikalische Chemie as follows: The contractor will investigate growth formation of boron clusters using mass selected beams produced from a cesium sputter source. These experimental results will be compared with theoretical analysis conducted by the Propulsion Directorate at Edwards AFB, CA. A technical report discussing the results obtained and analysis to the theoretical studies will be delivered at the completion of this 12 month study. Payment will be made on the delivery and acceptance of this report.				
14. SUBJECT TERMS EOARD, Chemistry, Energetic Materials, Propellants			15. NUMBER OF PAGES 4	16. PRICE CODE N/A
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18  
298-102

20010806 100

## Final Report

### “ Characterization of Boron Atom Aggregation” (SPC 00-4073)

The project was primarily aimed at obtaining electronic spectra of boron aggregates. A unique facility is available for this; an apparatus developed in Basel during the last decade which combines mass-selection with matrix isolation spectroscopy. Figure 1 shows the concept of this complex instrument .

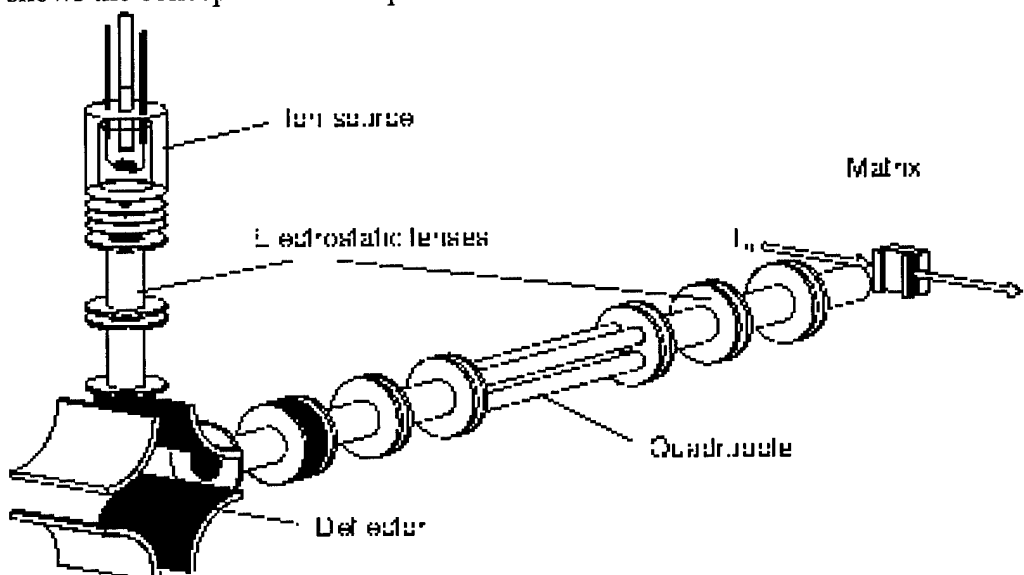


Figure1.

An objective set for the six month period (1.October 2000- 31. March 2001) of the project was achieved, in that the electronic spectra of  $B_3$  and  $B_3^-$  in a neon matrix could be observed for the first time. In the initial submission, finances for a year's project including support for a PhD student were requested. However, as the amount available was \$ 15'000.- the project was rescaled for about a 6 month period: the salary for a PhD student in Switzerland is around \$ 20'000 per year. Muriel Wyss and Evgueni Riaplov were the students who worked on this project during this period. Collaboration, consultation and exchange of information was maintained with Dr.C.W.Larson of the Air Force Research Laboratory, Edwards, AFB.

The  $B_3$  molecule plays a key role in the characterization of boron “High Energy Density Matter”. It has been theorized that  $B_3$  may be an “island of stability” in boron High Energy Density Matter because it may resist attack by B and  $B_2$  to form higher clusters. Thus the observation of the electronic spectrum is an important step for the further experimental investigations. To obtain the spectra,  $B_3^-$  anions produced by cesium sputtering on a boron carbide rod were mass-selected and codeposited with neon on a 5 K surface to grow a matrix. In this the  $B_3^-$  anions are trapped as isolated entities. The absorption of  $B_3^-$  is observed with origin band at 448 nm (figure 2) and is the  $A^1\Pi_u - ^1\Sigma_g^+$  electronic transition.

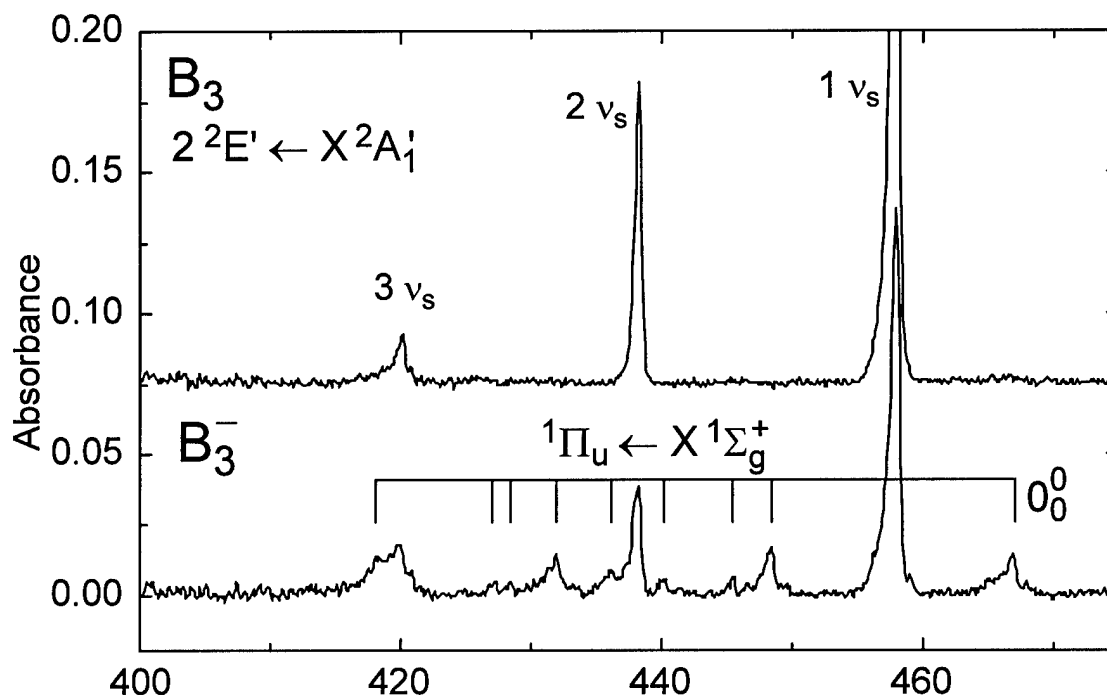


Figure 2.

The anion is then converted through photolysis to  $B_3$  in the matrix and shows two electronic transitions, one with origin band at 736 nm ( $1^2E' - X^2A_1'$  figure 2) and other at 458 nm ( $2^2E' - X^2A_1'$  figure 3).

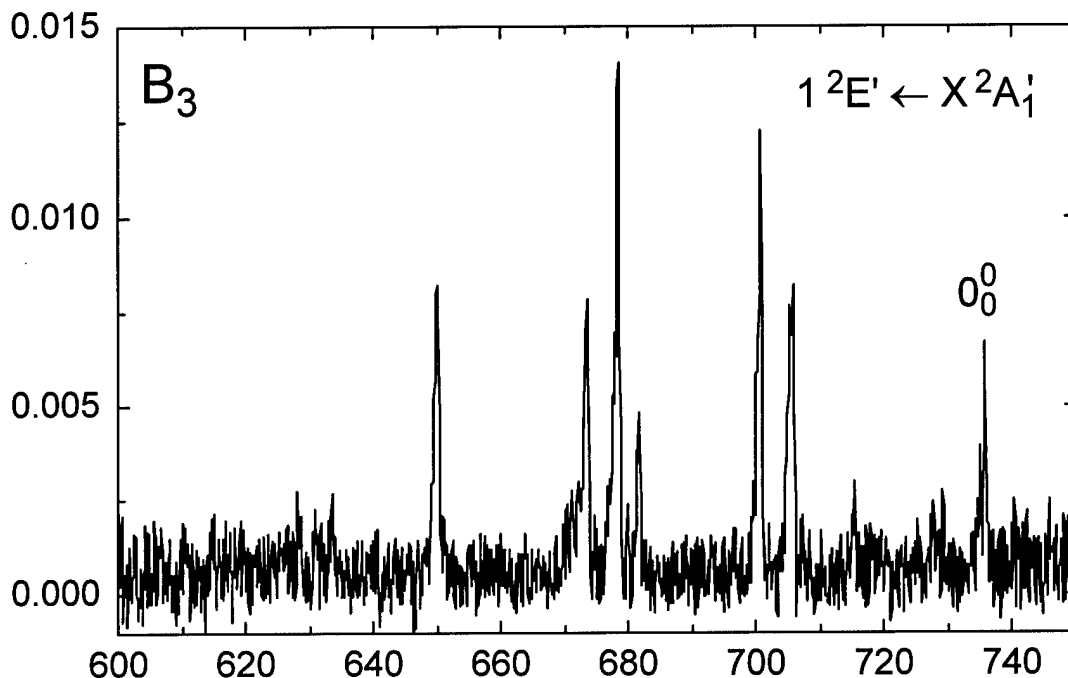


Figure 3.

An article reporting these new spectra is being prepared. However, the interpretation of the vibrational structure of the spectra requires theoretical support: the excited electronic states are degenerate and subject to a Jahn-Teller distortion. The theory for this is being developed by the group of Prof.P.Rosmus, Universite de Marne la Vallee, France, with whom we have a collaboration.

Experiments were also attempted to observe the spectra of  $B_4^-$ , using mass-selected  $B_4^-$ , so far without success. This is associated with inadequate ion currents, 0.5 nA for  $B_4^-$  has been the best attained, and will require in the future source development, including perhaps the use of boron complexes as precursors.

The first experiments to follow boron atom aggregation were also attempted. In this, mass-selected  $B^-$  atoms were codeposited with neon and the matrix was warmed up from 4 to 8 K. This increases the mobility of the boron atoms causing the formation of boron molecules. The ready formation of the molecule OBO was observed. It is produced because of trace amounts of oxygen in the neon matrix.

(1) "The Contractor, Institute for Physical Chemistry, hereby declares that, to the best of its knowledge and belief, the technical data delivered herewith under contract No. F61775-00-WE073 is complete, accurate and complies with all the requirements of the contract."

**DATE** 14. May, 2001

**Name and Title of Authorized official:** John P.Maier, Professor, Director of Institute of Physical Chemistry "

(2) **(B)** " I certify that there were no subject inventions to declare as defined in FAR 52.227-13, during the performance of this contract. "

**DATE** 14. May, 2001

**Name and Title of Authorized official:** John P.Maier, Professor, Director of Institute of Physical Chemistry "

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