Boron Fullerenes ($C_{12}B_{24}N_{24}$)
Laser Ablation of Boron, Nitrogen, and Carbon

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Abstract
The production of carbon fullerenes has been widely observed and reproduced since their discovery; analogous structures with boron and nitrogen have been theoretically predicted to have greater stability. To accomplish the synthesis of these large boron clusters and fullerenes, specifically $C_{12}B_{24}N_{24}$, powdered compounds of carbon, boron, nitrogen, and silicon were compressed into a cylinder, cured, and then ablated with an Nd: YAG 532 nm laser under low flow of argon and nitrogen. The results were analyzed using a Time of Flight mass spectrometer. The targeted compounds were not produced, though several CN compounds were observed.

Time-of-flight Mass Spectrometry

In time-of-flight mass spectrometry, a laser is used to create an electric field of a known strength, which will accelerate ions through a path to a detector. Below is a schematic of a reflectron model, which, as its name would suggest, reflects the traveling ions from their original linear path to a detector angled below, increasing accuracy of the measurements taken. From the time taken to reach the detector, one can extrapolate the mass-to-charge ratio of the ion in question. The results are given in a form like Fig. 3.

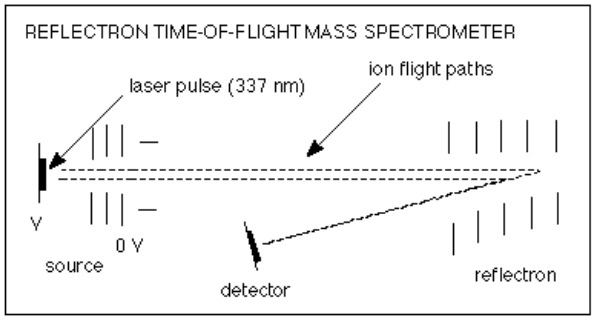


Fig. 1

Tip#	Date created	Compound(s)	Ratio	Mass(es)	Volume	# of ablations	Date of ablation	Gas
1	6/15	C	___	11g	20ml	1	6/20	Argon
2	6/16	B_4C	___	7.176g	15ml	1	7/21	Argon
3	6/17	BN:C	2:1	6.5014g : 1.5014g	20ml	1	7/26	Argon
4	6/28	B_4C:C	1:1	5.525g : 3.603g	20ml	1	7/29	Argon
5	6/29	BN	___	7.0004g	25ml	1	7/11	Argon
6	6/30	B_6Si:B_4C	1:2	4.6475g : 5.5255g	25ml	0	___	___
7	6/30	BN:C	1:2	4.9636g : 4.8044g	30ml	1	8/4	Nitrogen

Fig. 2

Conclusion

We did not succeed in making any large boron fullerenes, including the targeted $C_{12}B_{24}N_{24}$. Indeed, there appeared to be very few molecules that contained boron at all, the reason for which is unknown. Further inquiry into this topic will be necessary to yield any definite conclusions.

Results

In our result such as the results in the graph below there were peaks that showed promise, but upon analysis no large boron molecules were identified. Any peaks that were positively identified to contain boron were both small in mass/size and too low in concentration to be classified as a valid data point.

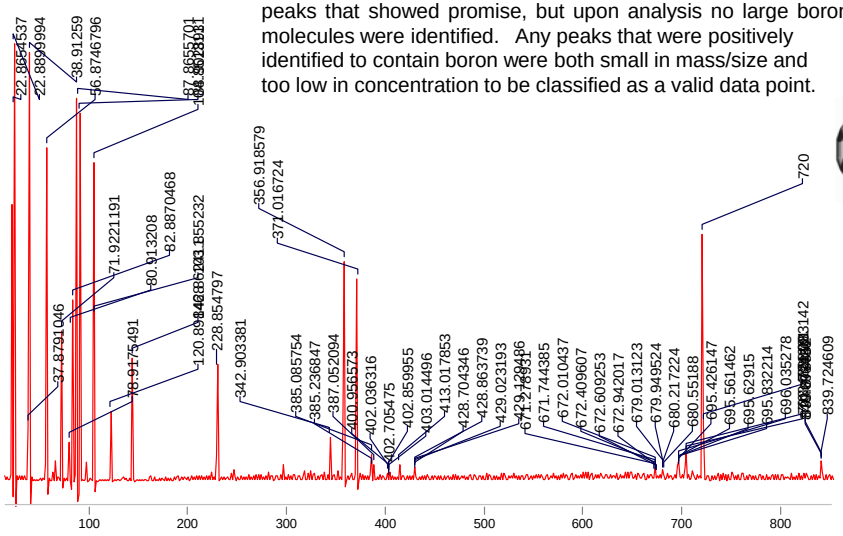
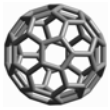


Fig. 3: Results for Tip 3.



At left is a representation of C_{60}, the first discovered buckminsterfullerene. Its structure is due to the ability of carbon to bond with itself in complex patterns, which is thought to be found in boron as well. The figure at bottom left is the theoretical representation of $C_{12}B_{24}N_{24}$, which has yet to be discovered in reality.

Acknowledgments

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Image acknowledgements:
http://www-klinowski.ch.cam.ac.uk/images/fullerenes_fig_2.jpg
https://nano.tu-dresden.de/~jkunstmann/img/boron_nano.jpg