LECTURE ABSTRACT

Photoelectron spectroscopy in combination with computational studies over the past decade has shown that boron clusters possess planar or quasi-planar structures,[1,2] in contrast to that of bulk boron, which is dominated by three-dimensional cage-like building blocks. All planar or quasi-planar boron clusters are observed to consist of a monocyclic circumference with one or more interior atoms. The propensity for planarity has been found to be a result of both σ and π electron delocalization over the molecular plane, giving rise to concepts of σ and π double aromaticity. To date, boron clusters with up to 27 atoms have been found to be planar.[3] A question arises, to what size will boron clusters remain planar? An even more interesting question is if infinitely large planar boron clusters are possible, giving rise to atom-thin boron nanostructures analogous to graphene. Because of its electron deficiency, boron cannot form graphene-like structures with a honeycomb hexagonal framework. Computational studies suggested that extended boron sheets with partially filled hexagonal holes are stable. We have found that B_{36} is a highly stable quasi-planar boron cluster with a central hexagonal hole (Fig. 1), providing the first indirect experimental evidence that single-atom layer boron-sheets with hexagonal vacancies are potentially viable.[4] B_{36} is the smallest boron cluster to have six-fold symmetry and a perfect hexagonal vacancy. It can be viewed as a potential basis for extended two-dimensional boron sheets, which we named "borophene". Our most recent studies revealed that the B_{40} cluster has an unprecedented cage structure (Fig. 2), which is the first all-boron fullerene to be characterized and is named "borospherene".[5] Further studies show that the B_{39}^- cluster consists of two nearly degenerate cage global minima, which are both chiral.[6] Thus, there may exist a family of borospherenes.

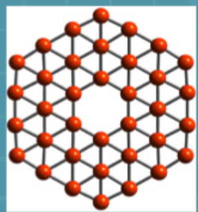

FIG. 1

The B_{36} Cluster

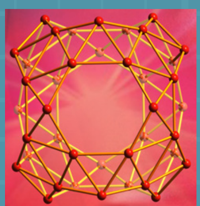

FIG. 2

The B_{40} Borospherene

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Questions and comments about the Dawson Lecture can be directed to Dr. Dong-Sheng Yang ***dyang0@uky.edu.***

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THE 19TH ANNUAL LYLE RAMSAY DAWSON LECTURE

Established in memory of
Lyle Ramsay Dawson
Distinguished Professor and
Former Head of the
Department of Chemistry

LAI-SHENG WANG

Department of Chemistry
Brown University

From Planar Boron Clusters to Borophene & Borospherene

Friday, October 16, 2015
4:00 PM
Chemistry-Physics Building
Room 139
Reception to Follow in Room 114

UNIVERSITY OF KENTUCKY
College of Arts and Sciences

LYLE RAMSAY DAWSON

Lyle Ramsay Dawson was a native of Illinois and received his undergraduate degree from the University of Illinois in 1932. He received his Ph.D. degree in 1935 from the University of Iowa.

Dr. Dawson served in several academic positions in Illinois, Wisconsin, Nebraska and Louisiana and also worked on the Manhattan Project as a Research Chemist and Group Leader in the Metallurgical Laboratory at the University of Chicago. In 1946, he was awarded the War Department's Certificate of Merit and a U.S. Patent for his efforts on the Manhattan Project, which led to the discovery of a fundamental process for the extraction and purification of the elements plutonium and neptunium. He was a member of the committee that organized the Oak Ridge Institute of Nuclear Studies and was a council member of the Institute.

Professor Dawson came to the University of Kentucky in 1945 as Head of the Department of Chemistry. He provided key leadership in initiating and building the doctoral program in Chemistry at the University. For example, in his first decade in the department, he individually obtained the major portion of extramural research support. During his twenty-five years with the Department, he held contracts for fundamental chemical research with the U.S. Army, the National Science Foundation and the Atomic Energy Commission.

He directed or co-directed seventeen Ph.D. dissertations and nine M.S. theses. He was a talented research director and had a special ability to imbue his students with a concise, clear and complete scientific writing style. He published more than fifty research papers dealing with the chemistry of nonaqueous solutions and coauthored a reference book on the subject.

Dr. Dawson was a master teacher both in the classroom and in less formal conferences and discussions. His leadership and mentoring led many graduate teaching assistants and junior faculty members to become more effective teachers. His uncompromising devotion to high achievement standards in course-work, research, education and training set the tone for our department for years to come. Another significant contribution to the Department was Professor Dawson's indefatigable advocacy for a new chemistry building. His leadership in soliciting and designing a replacement for the former chemistry building, Kastle Hall, culminated in the opening of the current Chemistry-Physics Building in 1963.

He also served the campus community in other ways. Dr. Dawson was elected a Distinguished Professor in the College of Arts and Sciences in 1954—1955, and was appointed to the rank of Distinguished Professor in the field of Physical Chemistry by the University of Kentucky Board of Trustees in 1956. He served as Acting Dean of the Graduate School in 1954—1955, 1956 and 1960—1961.

Dr. Dawson's contributions outside the University were well recognized. He was a Fellow of both the American Institute of Chemists and the American Association for the Advancement of Science. He was a member of the American Chemical Society, Electrochemical Society, Sigma Xi, Omicron Delta Kappa, Alpha Chi Sigma and Kappa Delta Pi, serving leadership roles in each of these organizations. He served several times as a Tour Lecturer and Visiting Scientist under the sponsorship of the American Chemical Society. He was also active in a variety of other nonacademic organizations.

Dr. Dawson's twenty-five years in the department represent a truly outstanding combination and balance of administrative leadership, teaching, research and service. Although Dr. Dawson passed away in 1976, his impact on the department continues to this day as we continue our evolution into a top-twenty research institution. The endowment of the Lyle Ramsay Dawson Lecture Series by his beloved daughter, Venita Dawson Curry, permits us to rejoice in this legacy and to continue our tradition of world-class chemical research.

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Lai-Sheng Wang is currently Jesse H. and Louisa D. Sharpe Metcalf Professor of Chemistry at Brown University. He is an experimental physical chemist known for his work on gold nanoclusters and planar boron clusters. He received his B.S. degree in Chemistry from Wuhan University in 1982 and his Ph.D. in Physical Chemistry from the University of California at Berkeley in 1990. After a postdoctoral stay at Rice University, he took a joint position between Washington State University and Pacific Northwest National Laboratory in 1993, then accepted an appointment as Professor of Chemistry at Brown University in 2009.

Prof. Wang has received the Alfred P. Sloan Research Fellowship and the John Simon Guggenheim Fellowship. He is a fellow of the American Physical Society and the American Association for the Advancement of Science. He has received the Humboldt Senior Research Award by the Alexander von Humboldt Foundation and the Earle K. Plyler Prize for Molecular Spectroscopy & Dynamics by the American Physical Society.