

# CRYSTAL AND POLYMER ENGINEERING METHODOLOGIES FOR THE APPLICATION OF BORON SUBPHTHALOCYANINE IN ORGANIC ELECTRONIC DEVICES (SOLAR CELLS AND OLEDs).

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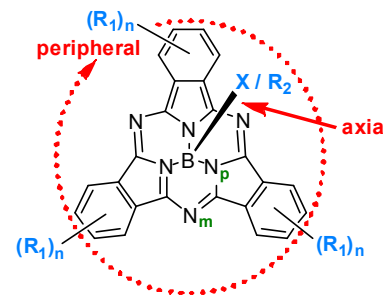
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The singularity of chloroboronsubphthalocyanine (Cl-**BsubPc**) has generated interest in its application within a variety of organic electronic devices. We have shown the **BsubPc** derivatives function well as n-type semiconductors and emitters in OLEDs where they show nearly perfect orange electroluminescence.[1,2] However, we have also determined that the solid state arrangement of Cl-**BsubPc**, other halo-**BsubPcs** and their associated phenoxy-**BsubPc** derivatives may not be suitable or optimal for efficient conduction of electrical charge in such devices.[3] This supposition has been made by studying the single crystal x-ray determined structures for the few available literature examples and numerous **BsubPc** derivatives made within our laboratory.



The first part of this presentation will highlight our most recent results in utilizing the principles of crystal engineering to direct the solid state arrangements of **BsubPcs** – each method envisioned and confirmed to be able to control the nanometer level organization of **BsubPc** derivatives into arrangements which are assumed to be advantageous for electrical conduction. (Method 1)  $\pi$ -Acid/ $\pi$ -Base Interactions: We have determined that **BsubPc** is a  $\pi$ -acid. Much like in simple acid/base chemistry we can use a  $\pi$ -base to form a bonding-type arrangement with the  $\pi$ -acidic **BsubPc**. [4] (Method 2) Halogen Directed Crystallization: We have determined that we can utilize both a Br- $\pi$  interactions and X-N interactions (X= Cl, Br, I; halogen bonding) to engineering new crystals forms of **BsubPcs**. [5]

The second part of the presentation will focus on our pursuit of a polymer of **BsubPc**. Polymers have processing advantages over their small molecular counterparts and as such are highly desirable for application in organic electronics. However, a **BsubPc** polymer has yet to be described in the literature. We will discuss our efforts to engineer a **BsubPc** polymer and comment on their current status.

Time permitting; I will discuss our pursuit of **BsubPc** derivatives which have bipolar electrochemical stability. [6]

Questions and comments are welcomed.

## REFERENCES.

- [1] Morse, G.E.; Helander, M.H.; Maka, J.; Lu, Z.H.; Bender, T.P.\*; *Appl. Mater. & Inter.*, **2010**, 2(7), 1934–1944.
- [2] Helander, M.H.; Morse, G.E.; Qiu, J.; Castrucci, J.; Bender, T.P.\*; Lu, Z.H.; *Appl. Mater. & Inter.*, **2010**, 11(2), 3147–3152.
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- [4] Paton, A.; Morse, G.E.; Lough, A.; Bender, T.P.\*; In preparation.
- [5] Virido, J.; Kwar, Y.; Lough, A.; Bender, T.P.\*; In preparation.
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**Short Bio:**

- B.Sc. 1996, Carleton University (Ottawa, Ontario)
- Ph.D. 1999, Carleton University (Ottawa, Ontario)
- NSERC Post Doctoral Fellow 1999 – 2001, Xerox Research Centre of Canada (Mississauga, Ontario)
- Member of the Research Staff 2001 – 2006, Xerox Research Centre of Canada (Mississauga, Ontario)
- Assistant Professor 2006 – current, University of Toronto Department of Chemical Engineering and Applied Chemistry (Toronto, Ontario)
- Cross Appointed Assistant Professor 2007 – current, University of Toronto Department of Chemistry (Toronto, Ontario)
- Chair – MSED Division – CSC and CSCHE Canada
- Program Chair – MSED Division – CSC Toronto 2010
- Program Chair – Canadian High Polymer Forum 2010

**Publications and Patents:**

- 60 Issued US Patents (as of 02-2011)
- 35 Peer Review Publications in Press

**Recent Awards:**

- 2008 Teacher of the Year, for Excellence in Teaching Large Class (Student voted), Department of Chemical Engineering and Applied Chemistry (Toronto, Ontario)