Shining Bright 2D Boron via Defects

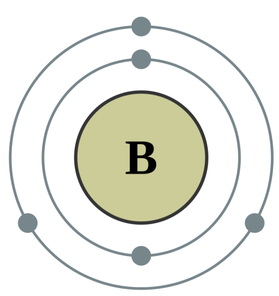
U. Anwar [1,2], L. Stagi [1], L. Malfatti [1,2], MF. Casula [2,3], P. Innocenzi [1,2]

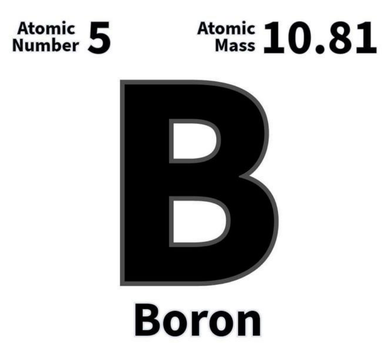
[1] Laboratory of Materials Science and Nanotechnology (LMNT), Department of Biomedical Sciences, University of Sassari, Sassari, Italy
[2] National Interuniversity Consortium of Materials Science and Technology (INSTM), Florence, Italy
[3] *Department of Mechanical, Chemical and Materials Engineering, University of Cagliari, Cagliari, Italy*

Background

Boron, often overlooked, plays a crucial role in various aspects of modern life, from borosilicate glass to medical treatments and energy innovations, making it a versatile and indispensable element deserving of more recognition.

Boron Nanosheets (BNS) has emerged as a new class of 2D material. Boron nanosheets possess exceptional physiochemical properties and it can have potential applications in optoelectronics and photonics.

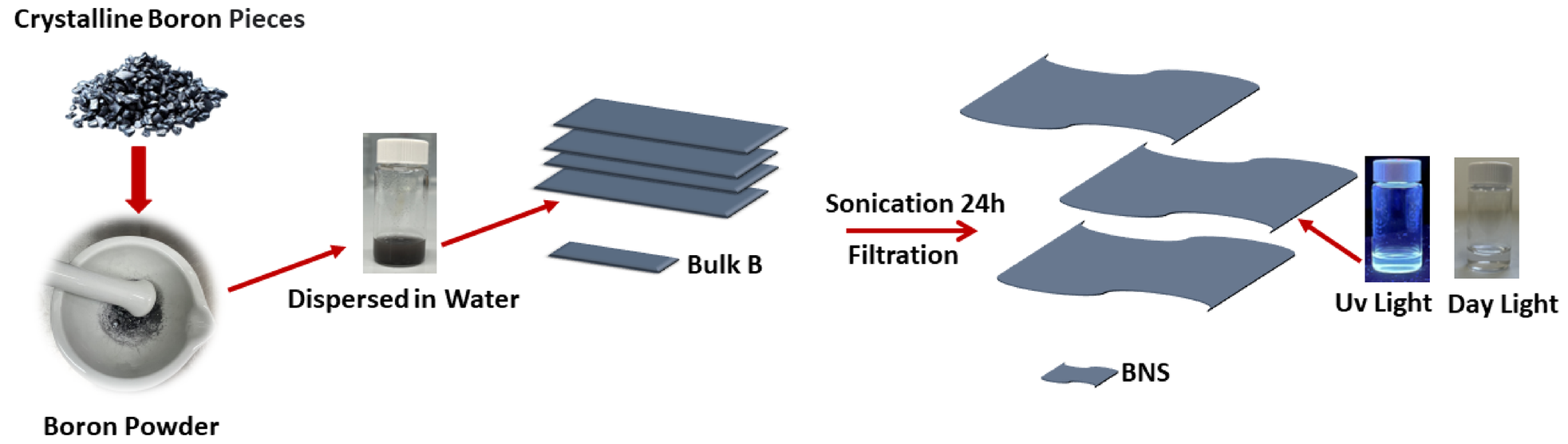


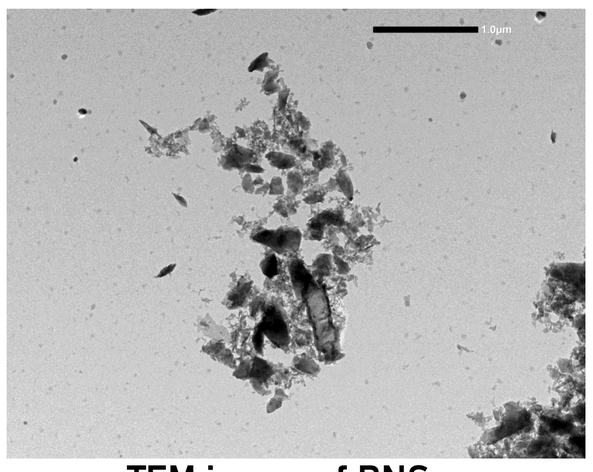


Aims and Objectives

- Generating defects within materials during and after synthesis.
- Exploring the influence of defects on optical properties.
- Engineering defects for enhanced optoelectronic properties.

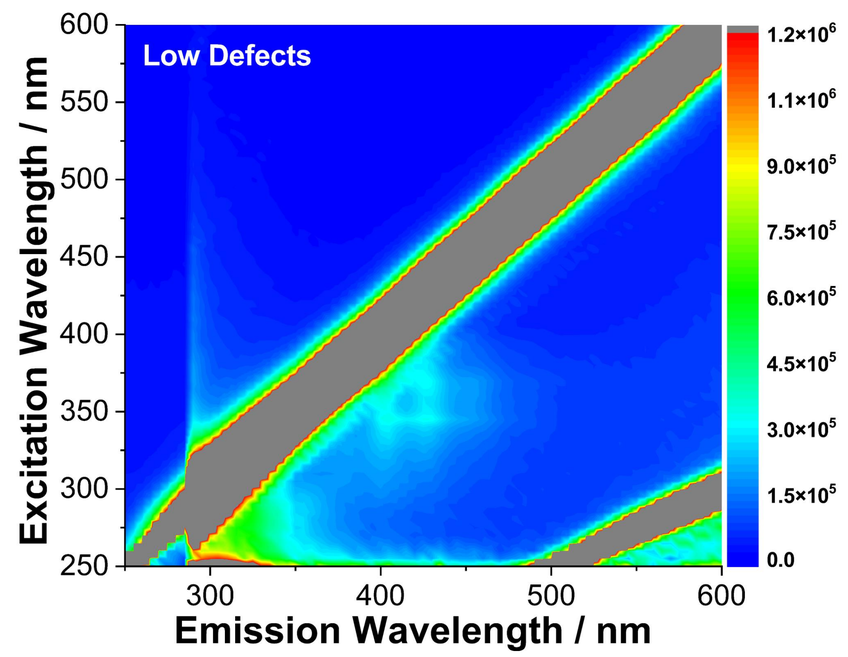
Top-Down Synthesis Approach and Evidence of Boron Nanosheets (BNS)



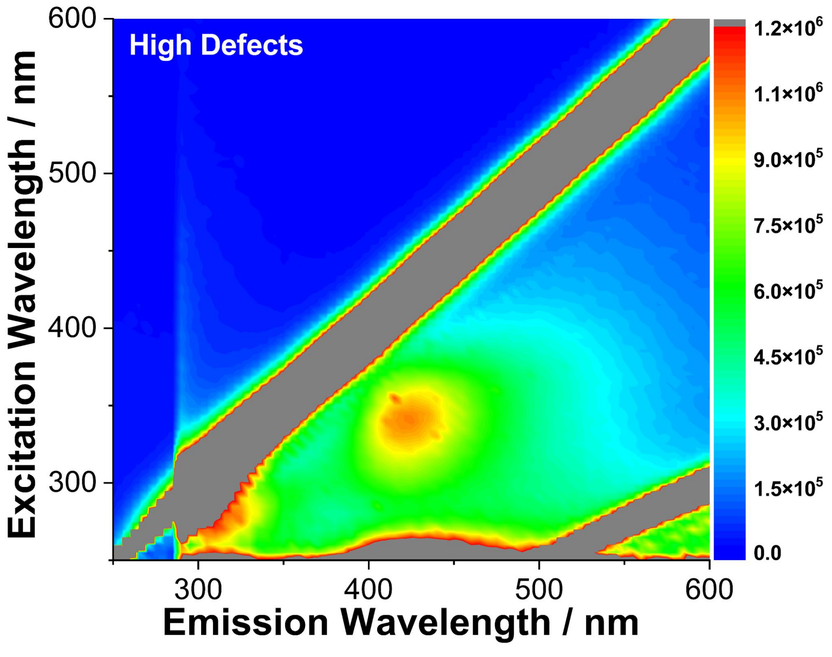


TEM image of BNS

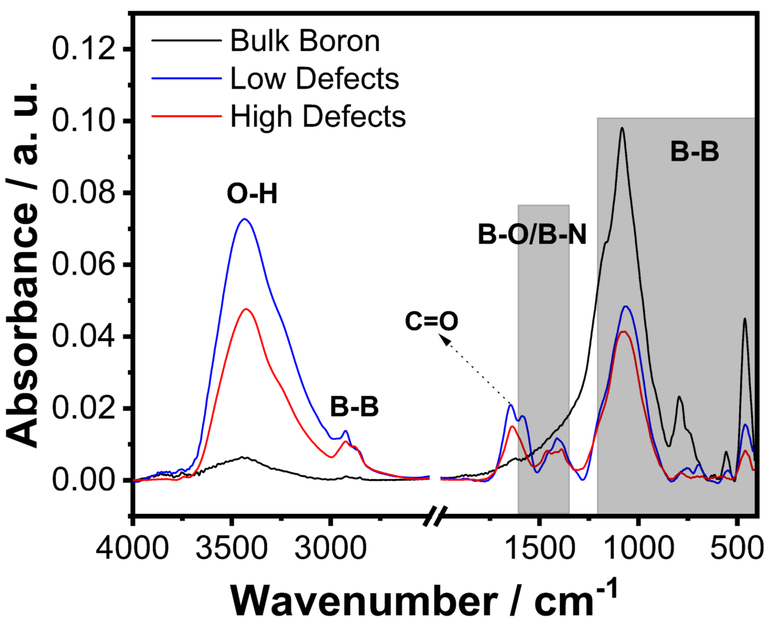
Defects-Driven Optical Dynamics



Excitation-Emission spectra of as Prepared Boron Nanosheets (Low Defects).



Excitation-Emission spectra of thermally oxidized Boron Nanosheets (High Defects).



FTIR spectra of Bulk Boron, as Prepared Boron Nanosheets (Low Defects) and thermally oxidized Boron Nanosheets (High Defects).

Conclusion and Future Prospectives

Defect-assisted fluorescence is a fascinating phenomenon in which defects within a material significantly impact its optical properties. The next step will be generating these defects in a controlled manner. This is important even if the potential applications of such materials, like emissive nanostructures, don't necessarily demand precise spatial control of the defects.

References

1. Zhang, Xin Stella, et al. "Boron nanosheets boosting solar thermal water evaporation." *Nanoscale* 16.9 (2024): 4628-4636
2. Ma, Dingtao, et al. "Ultrathin boron nanosheets as an emerging two-dimensional photoluminescence material for bioimaging." *Nanoscale horizons* 5.4 (2020): 705-713.
3. Innocenzi, Plinio, and Luigi Stagi. "From Defects to Photoluminescence in h-BN 2D and 0D Nanostructures." *Accounts of Materials Research* 5.4 (2024): 413-425.

UNISS
UNIVERSITÀ DEGLI STUDI DI SASSARI

UNICA
UNIVERSITÀ DEGLI STUDI DI CAGLIARI

Materials Science and Nanotechnology Laboratory

Scan the QR Code,
Visit our website