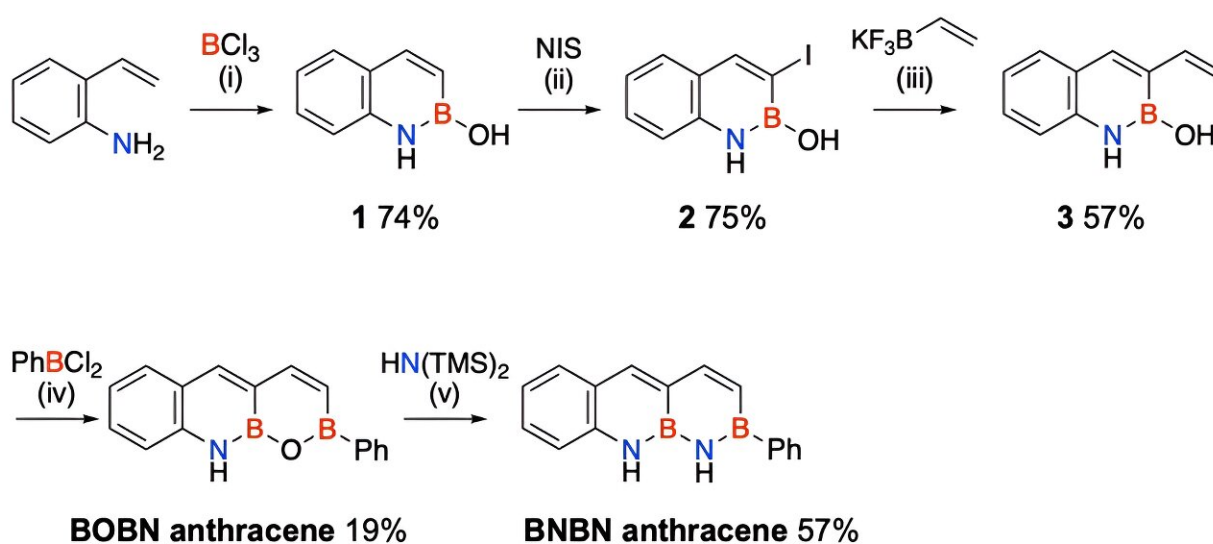


Breakthrough in organic semiconductor synthesis paves way for advanced electronic devices

December 15 2023, by JooHyeon Heo



Schematic image, showing the syntheses of BOBN anthracene and BNBN anthracene. Credit: *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202314148

A team of researchers led by Professor Young S. Park at UNIST's Department of Chemistry has achieved a significant breakthrough in the field of organic semiconductors. Their successful synthesis and characterization of a novel molecule called "BNBN anthracene" has opened up new possibilities for the development of advanced electronic

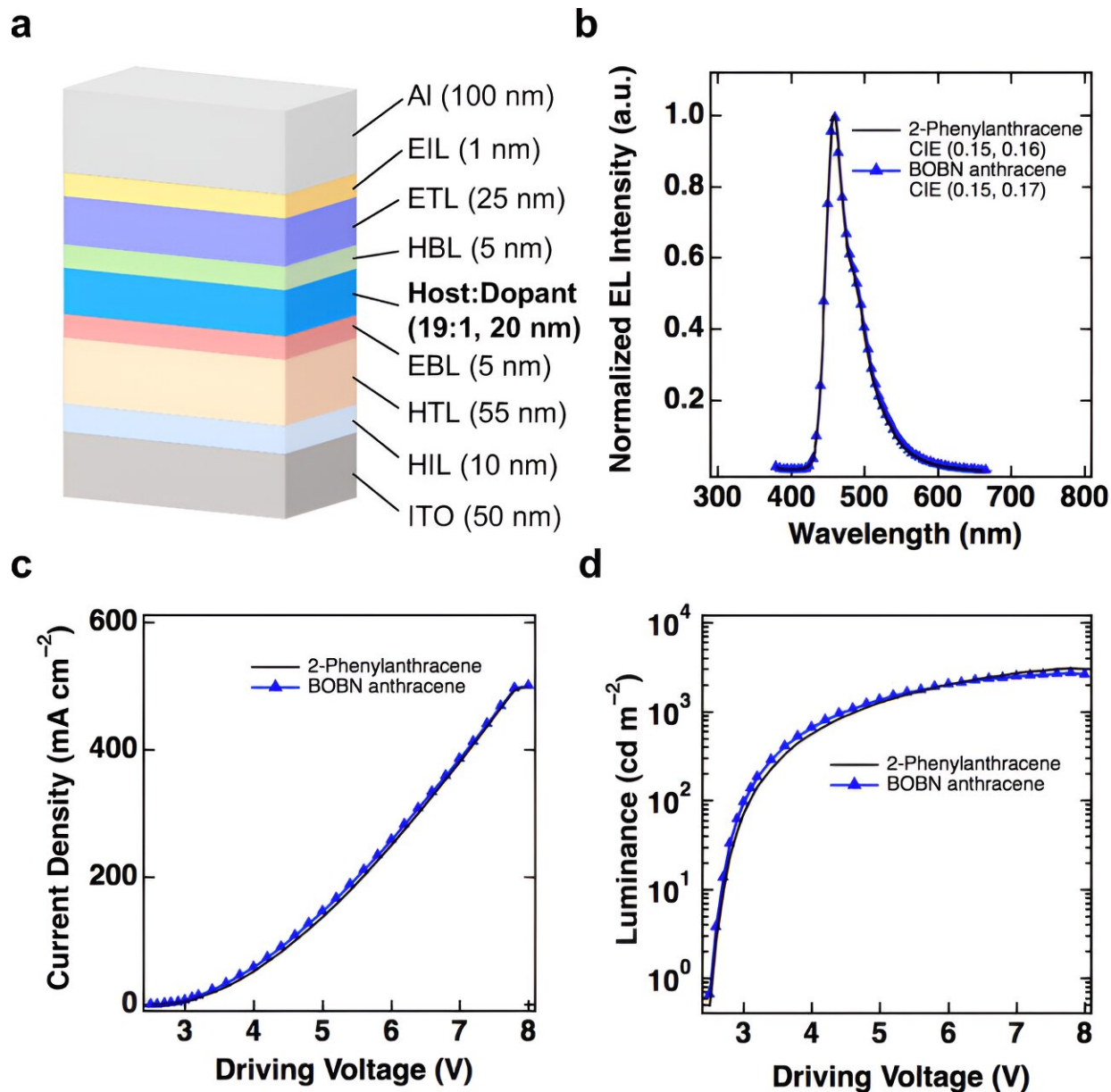
devices.

The paper is [published](#) in the journal *Angewandte Chemie International Edition*.

Organic semiconductors play a crucial role in improving the movement and light properties of electrons in carbon-centered organic electronic devices. The team's research focused on enhancing the chemical diversity of these semiconductors by replacing carbon-carbon (C–C) bonds with isoelectronic boron-nitrogen (B–N) bonds. This substitution allows for precise modulation of the electronic properties without significant structural changes.

The researchers successfully synthesized the BNBAN anthracene derivative, which contains a continuous BNBAN unit formed by converting the BOBN unit at the zigzag edge. Compared to conventional anthracene derivatives composed solely of carbon, the BNBAN anthracene exhibited significant variations in the C–C bond length and a larger highest occupied molecular orbital–lowest unoccupied molecular orbital energy gap.

In addition to its unique properties, the BNBAN anthracene derivative demonstrated promising potential for application in organic electronics. When used as the blue host in an [organic light-emitting diode](#) (OLED), the BOBN anthracene exhibited a remarkably low driving voltage of 3.1 V, along with higher efficiency in terms of current utilization, energy efficiency, and light emission.



Characteristics of OLED devices using BOBN anthracene (blue line) and 2-phenylanthracene (black line) as the blue host. (a) Device architecture of OLED. (b) Electroluminescence (EL) spectra of device recorded at 10 mA cm^{-2} . (c) Current density–driving voltage characteristics. (d) Luminance–driving voltage characteristics. Credit: *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202314148

The research team further confirmed the properties of the BNB anthracene derivative by studying its [crystal structure](#) using an X-ray diffractometer. This analysis revealed structural changes, such as bonding length and angle, resulting from the boron-nitrogen (BN) bonding.

"Our study on anthracene, a type of acene widely recognized as an organic [semiconductor](#), has laid the groundwork for future advancements in the field," said Songhua Jeong (Combined MS/Ph.D. Program of Chemistry, UNIST), the first author of this study. "The continuous BN bonding synthesized through this research holds great potential for applications in organic semiconductors."

Professor Park emphasized the significance of this breakthrough, stating, "The synthesis and characterization of compounds with continuous boron-nitrogen (BN) bonds contribute to [fundamental research](#) in chemistry. It provides a valuable tool for synthesizing new compounds and controlling their electronic properties."

More information: Seonghwa Jeong et al, Increasing Chemical Diversity of B₂N₂ Anthracene Derivatives by Introducing Continuous Multiple Boron-Nitrogen Units, *Angewandte Chemie International Edition* (2023). [DOI: 10.1002/anie.202314148](https://doi.org/10.1002/anie.202314148)

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