

Emerging Applications of van der Waals Boron Nitride Heterostructures for Advanced Electronics and Biomedicine

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Abstract:

The electrically insulating and optically transparent hexagonal boron nitride (h-BN) nanostructures are not applicable as the transport channel of electronic and energy devices. Recent advancements in controlled synthesis of high-purity boron nitride nanotubes (BNNTs, Chem Mater. 2010, Nanoscale 2010) and h-BN nanoparticles have enabled unique applications in advanced electronics and bio-imaging. For example, we reported using BNNTs as the one-dimensional templates for room-temperature single-electron transistors (SETs, Adv Mater 2013), and two-dimensional gold quantum dots with tunable optical bandgap (ACS Nano 2019). We also reported field-effect transistors (FETs) by van der Waals Tellurium (Te) atomic chains encapsulated inside BNNTs (Nature Elect. 2020). Last but not least, we have demonstrated high-brightness fluorophores for immunophenotyping of antigens by flow cytometry. In my talk, I will discuss these emerging applications (ACS Omega 2021, J. Mater. Res. 2022), and the latest use of h-BN nanoparticles as high-brightness probes (HBPs) for gene and troponin protein detection.

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Brief Professional Biography of Professor Yoke Khin Yap

Yoke Khin Yap is a professor of physics, director of the applied physics graduate program, and an honorable University Professor at Michigan Technological University (MTU), USA. He earned his Ph.D. in 1999 from Osaka University, sponsored by the Japanese government as a Monbusho scholar. Before his appointment at MTU, he was a postdoctoral fellow of the Japan Society for the Promotion of Science. His research interest focuses on synthesizing nanoscale van der Waals materials and their applications in electronics, energy, and biomedicine. Professor Yap was honored with the National Science Foundation CAREER Award in 2005. He was a Charter member of the users' executive committee of the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory in 2005-2007 and the first elected user group chair in 2008. Professor Yap received the Bhakta Rath Research Award in 2011, was appointed Faculty Fellow in 2014-2016, honored as an Osaka University Global Alumni Fellow in 2015, and received the MTU Research Award in 2018.



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