2D MBenes for Energy Storage and Conversion Technology

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The growing demand for sustainable and high-performance energy technologies has accelerated interest in two-dimensional (2D) materials. Among them, transition metal borides—MBenes—represent a promising class due to their high electrical conductivity, mechanical robustness, and tunable surface chemistry. As boron-containing analogs of MXenes, MBenes offer distinct advantages for energy storage and conversion applications.

This talk presents recent progress in MBene synthesis, functionalization, and application in supercapacitors, batteries, and electrocatalytic systems such as HER, OER, and ORR. We explore how boron-metal bonding, layer structure, and surface modifications influence electrochemical performance. Advances in molten salt synthesis and hybrid nanocomposite design have led to MBenes with excellent pseudocapacitive behavior, fast charge–discharge rates, and high energy density.

By bridging fundamental materials chemistry with practical device engineering, this presentation aims to shed light on the transformative potential of 2D MBenes in advancing sustainable energy conversion and storage technologies.

Müslüm Demir is a materials scientist specializing in energy storage, 2D nanomaterials, and CO_2 capture technologies. With over 100 peer-reviewed publications and extensive experience in academic and industrial research, he has made significant contributions to the development of MXenes, MBenes, and porous carbon-based hybrid materials for supercapacitors, batteries, and electrocatalysis. He is currently associate professor at Boğaziçi University and a senior researcher at TÜBİTAK-MAM.

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