הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Monday, September 1st, 2025, at 13:30

Room 6

Studies on Oxygen Reduction Reaction Catalysts for Anion Exchange Membrane Fuel Cells

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PhD Seminar

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The advancement of anion-exchange membrane fuel cells (AEMFCs) relies on the development of cost-effective and high-performance oxygen reduction reaction (ORR) catalysts. Here, we report the synthesis of metal-phthalocyanine (MPc) catalysts (M = Fe, Mn, Co, Cu, Ni, Li, and Sn) *via* a simple single-step, room-temperature ultrasonication process. N_2 adsorption-desorption isotherms and X-ray diffraction (XRD) analyses confirm successful MPc deposition onto Ketjen Black (KB) support. High-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) micrographs and the electron dispersive spectroscopy (EDS) maps reveal a homogeneous distribution of the MPc catalysts. The FePc/KB, MnPc/KB, and CoPc/KB demonstrated notable kinetic activity in rotating ring-disk electrode (RRDE) tests. When integrated into cathodes, the FePc-, MnPc-, CoPc-, CuPc-, and NiPc/KB catalysts exhibited notable *operando* H_2-O_2 AEMFC performance. Among these, the CoPc/KB catalyst achieved a specific peak power density of 605 mW $mg^{-1}_{catalyst}$, which was approximately three times higher than the best performance reported for analogous phthalocyanine-based catalysts. Likewise, FePc-, MnPc-, CoPc-, and NiPc/KB showed a specific peak power of 116, 625, 338, 1167% higher, respectively, than the best MPc catalysts previously reported. This work establishes a direct correlation between the ORR catalytic performance of MPc/KB materials and their efficiency as AEMFC cathodes, offering valuable insights for future catalyst design and the widespread adoption of sustainable phthalocyanine-based catalysts and AEMFC technology.