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Polymer Engineering

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Anion exchange membranes for electrochemical applications

Ms. Anna Suslonova

MSc Candidate, The Interdisciplinary Program in Polymer Engineering

Advisor: Prof. Dario R. Dekel

Oxygen is essential for medical care and many industrial processes, yet its supply remains dependent on centralized production and transportation. Here we present a systematic evaluation of a novel electrochemical process based on an anion-exchange membrane oxygen separator (AEMOS), operating in an all-solid-state, liquid-electrolyte-free, gas-fed configuration that enables compact, mobile, and on-demand oxygen generation.[1] We explore and characterize AEMOS operating conditions and membrane electrode assemblies, finding that under optimized operation the device achieves maximum current densities of approximately 700 mA cm^{-2} (corresponding to about 160 mL_{O2} h^{-1} cm^{-2}) in a configuration comparable to previously reported systems. Notably, this performance exceeds the best previously reported values by about fourfold.[2,3] Remarkably, AEMOS attains performance *on par with* noble-metal-based systems while relying solely on earth-abundant catalysts. Moreover, we demonstrate, for the first time, direct operation of AEMOS in ambient air. Together, these results establish AEMOS as a platform for decentralized, climate-compatible oxygen separation and on-site generation.

(1) Dekel, D. R. Method and System for Separating Oxygen. WO2025238638A1, November 20, 2025.

(2) Faour, M.; Yassin, K.; Dekel, D. R. Anion-Exchange Membrane Oxygen Separator. *ACS Org. Inorg. Au* **2024**, *4* (5), 498–503. https://doi.org/10.1021/acsorginorgau.4c00052.

(3) Zhang, M.; Suslonova, A.; Zhong, J.; He, X.; Dekel, D. R. Solid-State Oxygen Separation from Air Using Imidazolium-Functionalized Anion Exchange Membranes. *Front. Membr. Sci. Technol.* **2025**, *4*, 1732112. https://doi.org/10.3389/frmst.2025.1732112.