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Laboratory-Synthesised Manganese Oxide Catalysts for Zinc-Air Battery Air Cathodes: A Survey of Research at the University of Dar es Salaam,

K, a, r, i, m, A, b, d, e, l, -, M, a, l, e, k, ,, M, o, n, a, H, a, s, s, a, n, ,, N, a, d, i, a, A, l, -, M, a, s, r, y, ,, A, h, m, e, d, E, l, -, S, a, y, e, d

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Abstract

Zinc-air batteries present a low-cost energy storage technology, limited by the performance and expense of the air cathode catalyst. Manganese oxides (MnOx) are a leading non-precious metal candidate. This survey examines research on this topic conducted at the University of Dar es Salaam. This article systematically reviews and critically evaluates research from the University of Dar es Salaam on laboratory-synthesised MnOx catalysts for zinc-air battery air cathodes. It aims to consolidate methodologies, material properties, and electrochemical findings to delineate established knowledge and persistent research gaps. A systematic survey was undertaken of relevant published journal articles, conference proceedings, and postgraduate theses from the institution. The analysis focused on experimental methods for MnOx synthesis, physical characterisation techniques, and electrochemical testing protocols for both half-cells and full zinc-air cells. The survey identified a predominant focus on amorphous MnOx phases produced via low-temperature synthesis routes. A central theme was the inherent compromise between catalytic activity for the oxygen reduction reaction and low electronic conductivity. Consequently, most studies investigated the integration of conductive carbon additives directly during catalyst synthesis to address this limitation. The research programme established a substantive, locally relevant knowledge base for fabricating MnOx cathode materials. It

defined viable, low-cost synthesis pathways and clarified critical material constraints, particularly regarding electrical conductivity and stability in alkaline electrolytes, which remain core challenges. Future work should prioritise the systematic investigation of crystalline MnOx phases and more advanced composite architectures with conductive supports. Research must transition towards standardised, long-term durability testing under realistic operating conditions to assess commercial feasibility. zinc-air battery, manganese oxide, electrocatalyst, air cathode, materials synthesis, electrochemical performance, survey. This survey provides a consolidated synthesis of a defined research corpus, offering a focused reference on the development and properties of MnOx catalysts for metal-air batteries within a specific institutional context.