TRANSITION METAL AND ZIF-8 CO-DOPED CARBON NANOTUBE CATALYSTS FOR OXYGEN REDUCTION IN ALKALINE SOLUTION

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Non-precious metal catalysts have been extensively investigated for oxygen reduction reaction (ORR) due to their high stability and activity in alkaline solutions [1]. In the last decade, anion exchange membrane fuel cells (AEMFC) have attracted the attention of researchers as it offers a great alternative to convert chemical energy into electrical energy [1,2]. In this work, we have prepared transition metal and ZIF-8 co-doped carbon nanotube (CNT)-based electrocatalysts and investigated their ORR activity in alkaline solutions. The catalysts were prepared via pyrolysis at 900^{o}C in N_2 environment. The catalyst materials were thoroughly characterised using transmission and scanning electron microscopy, X-ray photoelectron spectroscopy, N_2 physisorption, X-ray diffraction and Raman spectroscopy. Fe, Co, and ZIF-8 co-doped CNT electrocatalyst (FeCo/ZIF-8/CNT-900) showed the best ORR performance in 0.1 M KOH with half-wave potential ($E_{1/2}$) of 0.854 V vs. RHE. The BET surface area for FeCo/ZIF-8/CNT-900 was found to be 312 m^2 g^{-1} and the total pore volume of 0.66 cm^3 g^{-1} with an abundance of mesopores having the dft surface area (S_{dft}) of 181 m^2 g^{-1}. The pore width was estimated to be in range of 10-20 nm. From the XRD studies, the presence of FeCo alloy nanoparticles along with graphitic carbon peak were found. The best electrocatalysts were tested as cathode materials in an AEMFC. The synthesised electrocatalysts showed a high oxygen reduction activity with direct four-electron transfer pathway and promising AEMFC performance.

References

1. A. Sarapuu, E. Kibena-Põldsepp, M. Borghei, K. Tammeveski, J. Mater. Chem. A 6 (2018) 776-804.
2. M.M. Hossen, M.S. Hasan, M.R. Islam Sardar, J. bin Haider, Mottakin, K. Tammeveski, P. Atanassov, Appl. Catal. B: Environ. 235 (2023) 121733.

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