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IV Reunião Bienal da Sociedade Brasileira de Eletroquímica e Eletroanalítica

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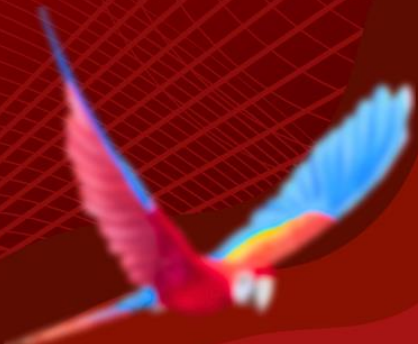
ANAIS DA IV REUNIÃO BIENAL DA SOCIEDADE BRASILEIRA DE ELETROQUÍMICA E ELETROANALÍTICA

24 E 25 DE OUTUBRO DE 2024



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Enhanced Electrochemical Ammonia Synthesis from N_2 using Metal Phosphide Nanoparticles on 3D Porous Graphene

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Ammonia is an essential chemical commodity and a candidate as a green energy vector. However, industrial manufacturing relies on the Haber-Bosch process. The conventional H-B method requires high energy density and generates millions of tons of CO_2 annually [1]. Electrochemical ammonia synthesis driven by renewable energy sources is a promising approach to replace the conventional H-B process due to operating in mild conditions. Despite the advantages, the ENRR still faces challenges such as low faradaic efficiencies, uncompetitive yield production, and slow kinetics. In this scenario of early-stage application [2], developing efficient electrocatalysts is essential for achieving favorable performances. Transition metal phosphides are interesting materials for several reduction/hydrogenation reactions. The present work reports the investigation of Fe and Co-based metal phosphides as catalysts for the electrochemical N_2 reduction to ammonia. For the nitrogen reduction reaction, nanoparticles of individual metal phosphides of Fe and Co- and FeCo-supported graphene were synthesized via a biomass-hydrogel method followed by thermal reduction. The synthesized materials were evaluated for their catalytic activity in the electrochemical reduction of N_2 in 0.1 M Na_2SO_4 at a constant potential electrolysis from -0.20 to -1.2V vs RHE. The FeCo phosphide presented a 3-fold increase in the NH_3 production rate compared to the individual metal phosphide, suggesting a synergistic effect of the Fe, Co bimetallic active sites.

Acknowledgments:

FAPESP (2020/11756-2, 2013/07296-2, #2022/15742-1), CNPq, FINEP, CAPES

References:

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[2] Ma et al. Nano Research., 555–569, 2021.