

A Comparative Study of Bi, Sb, and BiSb for Electrochemical Nitrogen Reduction Leading to a New Catalyst Design Strategy

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Recent studies identified Bi as one of the most promising non-noble metal elements that can promote the electrochemical N₂ reduction reaction (ENRR) to produce NH₃. The electronic features that make Bi a promising ENRR catalyst may also be owned by Sb that belongs to the same group as Bi. Thus, the ENRR properties of Bi, Sb, and a BiSb alloy were investigated comparatively to identify common characteristics that facilitate the ENRR. These catalysts were prepared as uniform coating layers on high surface area carbon felt electrodes, which could serve as both regular electrodes and pseudo-gas diffusion electrodes. The experimental results demonstrated that while Bi and Sb show comparable ENRR performances, the formation of a BiSb alloy distinctively increases the Faradic efficiency for NH₃ production. Additionally, this study investigated how the use of gas phase and dissolved N₂ affected the ENRR performances of the Bi, Sb, and BiSb catalysts.