Strategies to Enhance Electrochemical Nitrogen Conversion to Ammonia

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The electrochemical nitrogen reduction (ENRR) has greatly attracted research interest as a way to directly convert dissolved nitrogen (N2) in aqueous media to ammonia (NH3), which is not only a useful commodity in industry but also a carbon-free sustainable energy source. It provides an environmentally benign pathway to produce NH_3 under ambient temperatures and pressures, using water as the hydrogen source. The primary current challenge of ENRR is its low Faradaic efficiency (FE) for NH3 production because the standard reduction potential of N_2 to NH_3 ($N_2(g) + 8H^+ + 6e^- \rightleftharpoons 2NH_4^+(aq)$, $E^0 = 0.275$ V vs. SHE) is very close to that of water to hydrogen. Furthermore, since the ENRR is much more kinetically complex than the hydrogen evolution reaction (HER), ENRR cannot efficiently compete with HER. To date, non-noble metal-based catalysts that have achieved the FEs greater than 10% are very scarce. In this talk, we will present multiple effective strategies on non-noble metal based catalysts to increase the FE for NH_3 production and how each modifications affects catalytic properties.