

# Iron Based Catalysts for Green Ammonia Synthesis

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Ammonia (NH<sub>3</sub>) is a fundamental feedstock for the global population not only for its wide use as fertilizer and chemical, but also for its potential as energy storage medium. Currently, ammonia is industrially produced by the Haber–Bosch process, from N<sub>2</sub> and H<sub>2</sub> feeding gases and Fe-based catalyst, operating at high temperature (400-500°C) and high pressure (150-300atm), thus making it highly pollutant. Electrochemical Nitrogen Reduction Reaction (e-NRR) using aqueous electrolytes is considered an interesting approach since it can be powered by renewable electricity inputs. In this work we adopted as e-NRR catalyst Fe based nanoparticles on carbon cloth substrate via a simple and fast electroless deposition technique adopting FeCl<sub>3</sub> solutions at different concentrations. We have developed a very efficient activation procedure based on cyclic voltammetry under N<sub>2</sub> flow that allowed an improvement up to 10 times in the ammonia generation rate. Moreover, a strong correlation has been found between the particle size of the catalyst and its activity for e-NRR, with the best results achieved with the sample covered with small nanoparticles (70nm in size). Iron based nanoparticles showed excellent activity for e-NRR, with a faradaic efficiency of 15% at -0.35 V vs RHE and a maximum ammonia production rate of 85µg mg<sup>-1</sup>cat h<sup>-1</sup>.

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