

# Electrochemical Synthesis of Ammonia from Nitrogen and Water at Ambient Conditions

Shreya Mukherjee, Hao Zhang, Gang Wu

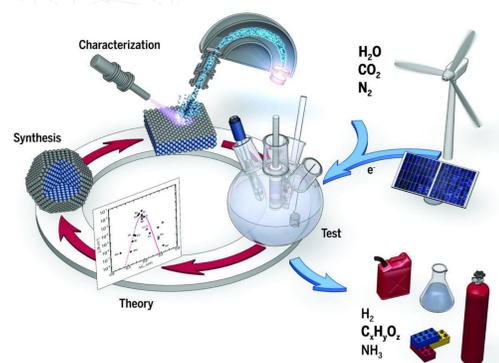
Department of Chemical and Biological Engineering, University at Buffalo, The State University of New York, Buffalo, New York 14260

## 1 Vision

**Long term Objective :** Back up of Haber Bosch Process : synthesize ammonia with minimum energy and without using H<sub>2</sub>

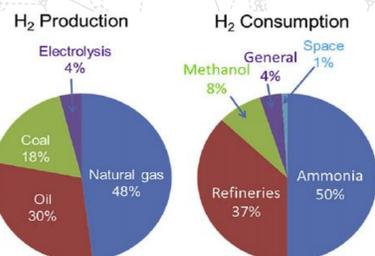
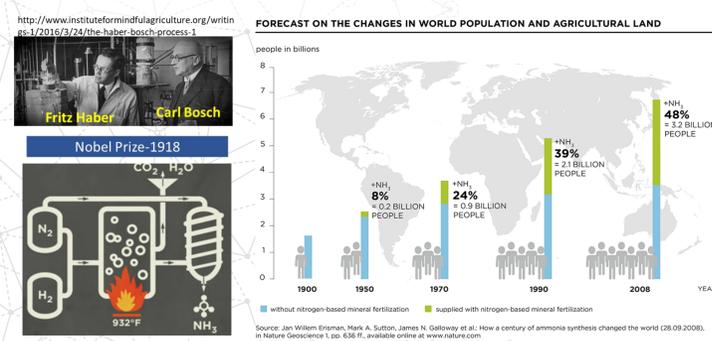
**Major Limitation :** Extremely slow kinetics of the process

**Possible Solution :** Develop catalyst that can reduce nitrogen at ambient conditions



<http://www.dtu.dk/nyheder/2017/01/elektrokatalyse-kan-sikre-groen-omsalling?id=fa31e2ea-9427-418e-9437-318dfb497816>

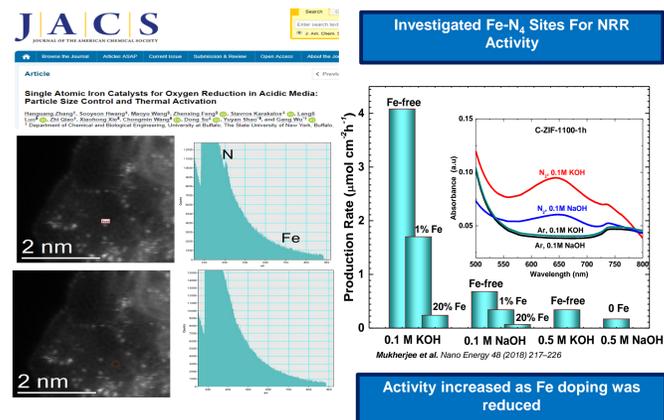
## Background :



**Our Goal**  
Synthesize ammonia without using H<sub>2</sub> at ambient conditions

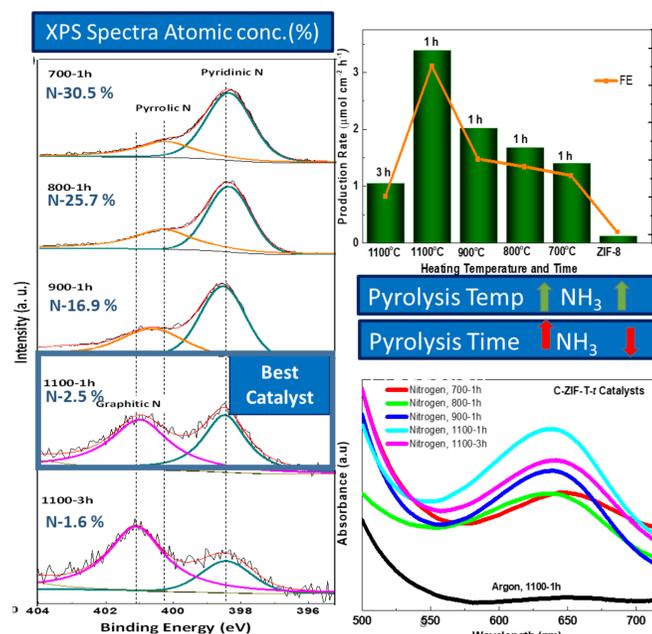
## 2 Approach

**Area :** Development of Electro Catalysts for synthesizing NH<sub>3</sub> at ambient conditions  
**Focus :** Non-Precious Metal Free Catalyst

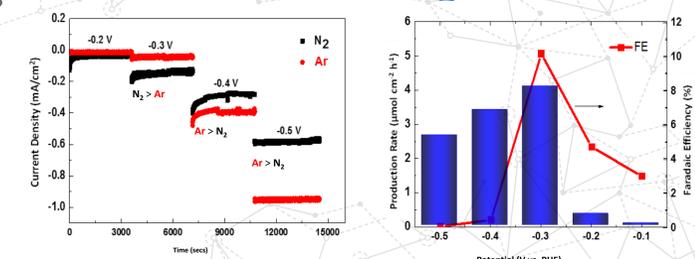


## 3 Development

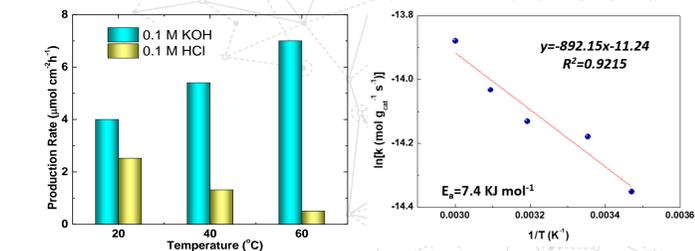
**Optimization :** Tuning pyrolysis condition to tune N content



## 4 Current Status & Future plan



Activation energy required in Haber Bosch process with triply promoted catalyst is 103 kJ/mol



- FE of 10 % have been achieved without using any precious metal
- Ammonia production rate is comparable and even higher than some precious metal catalyst
- Single atom like Ni, Ru on such carbon framework can be synthesized to further increase the activity

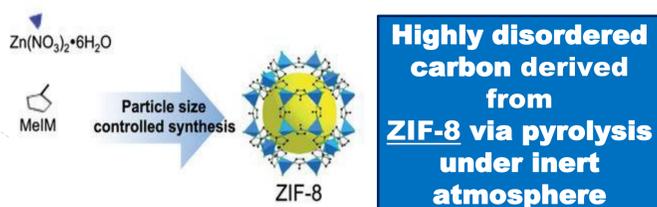
## Acknowledgement

Financial supports from the startup fund of University at Buffalo along with U.S. Department of Energy, Advanced Research Projects Agency-Energy (ARPA-e) program are greatly acknowledged.



Department of Chemical and Biological Engineering  
School of Engineering and Applied Sciences

## Catalyst Synthesis :



## Active Site Prediction:

