Characterization of FeNi catalyst through TPR and Pulse Chemisorption

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Microelectronics | Nanoscience & Engineering

Background/Relevance

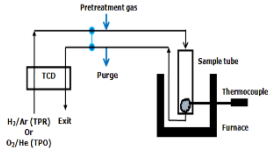
- NH_3 is one of the most abundantly produced chemical in the world. It is more famously used in agriculture as a fertilizer.
- It is made under the Haber Bosch process which requires high temperatures (250-300C) and pressures (100-200 atm), it takes up approximately 2% of worlds energy consumption.
- Electrochemical reduction of N_2 and H_2 has been identified as an alternative approach to produce NH_3 at lower conditions.

Innovation

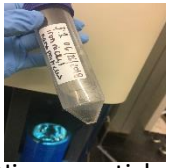
Design an electrochemical cell to put in the Chemstar for nitrogen reduction reaction.

Approach

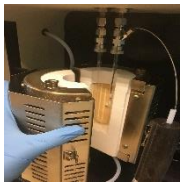
- Characterize nanoparticle catalyst through Temperature Programmed reduction and Pulse Chemisorption.
- Synthesize different molar ratio (3:1, 1:1, 6:1) FeNi nanoparticles.



- Schematic of TPR analysis



FeNi nanopaticles



Furnace

Chemstar

Key Results

- A comparison of TPR and pulse chemisorption was done on Fe_3O_4 and Fe_2O_3.
- The red curve (Fe_2O_3) shows that pulse chemisorption was done before tpr while the black curve (Fe_3O_4) shows that pulse chemisorption was done before TPR.
- **Figure 2** is a comparison of Fe_2O_3 Pulse chemisorption before tpr vs pulse chemisorption after TPR.

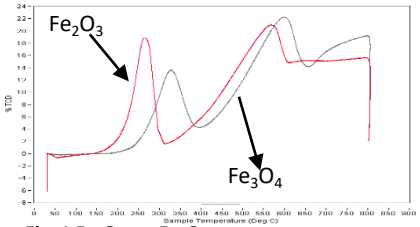


Fig. 1 Fe_2O_3 vs Fe_3O_4

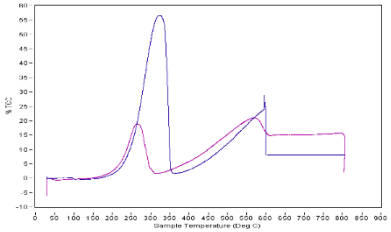


Fig 2 . Fe_2O_3 TPR before and after pulse chemisorption

Conclusions

- It was observed that when pulse chemisorption is done before TPR, a much higher peak is produced.
- Fe_3O_4 has a higher peak than Fe_2O_3 which means more gas is been adsorbed when pulse chemisorption is carried out before TPR.
- Multiple peaks indicate the presence of metal in different forms on the support of having different level of between species and support.
- Fe_2O_3 was reduced by 251.520%
- Fe_3O_4 was reduced by 497.025%

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