University of Louisville
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Literature Seminar

When: December 4, 2023
Time: 3:00 p.m.
Location: CBLL-16

Single Atom Alloy Catalyst for Electrochemical Synthesis of Ammonia

Abstract:

The Haber process, in the past more often referred to as the Haber-Bosch process, is one of the towering achievements of industrial chemistry. The synthesis of ammonia from the Haber-Bosch process leads to the formation of CO_2, resulting in the greenhouse effect and global warming. Therefore, chemists are interested in developing electrochemical methods of ammonia synthesis because they are environmentally friendly. Ammonia electrosynthesis from a variety of nitrogen species via renewable electricity has great potential impact on the environment, energy, and sustainability. So far, single atom alloy catalysts have drawn attention as electrocatalysts since their unique structures are able to regulate both catalytic activity and selectivity with theoretical 100% atomic utilization toward various electrochemical reactions. In this literature seminar, the use of single atom alloy catalysts in electrochemical reduction of nitrate to ammonia will be discussed through three examples from literature, where Cu serves as a base material in each case. In the first paper, Cheng Du and co-workers used single atom Pd on Cu as a catalyst to achieve 97.1% faradaic efficiency of ammonia production with a yield of 15.4 μmol cm^{-2} h^{-1}. In the second paper, Haibo and co-workers employed single atom Au on Cu to increase both the yield and faradaic efficiency of ammonia. Finally, Jinmeng Cai and co-workers were able to maximize the yield (326.7 μmol cm^{-2} h^{-1}) and faradaic efficiency (nearly 100%) using single atom Ni on Cu as the catalyst. This seminar will describe the synthesis, characterization, and catalytic mechanism of these three different catalytic systems.

References:

1. Zhang, Q.; Guan, J. *Adv. Fun. Mat.*, **2020**, *30*, 2000768.
2. Du, C.; Lu, S.; Wang, J.A.; Wang, X.; Wang, M.; Fruehwald, H.M.; Wang, L.; Zhang, B.; Guo, T.; Mills, J.P.; Wei, W. *ACS Catalysis*, **2023**, *13*, 10560-10569.
3. Yin, H.; Peng, Y; Li, J. *Env. Sci. & Tech.*, **2023**, *57*, 3134-3144.
4. Cai, J.; Wei, Y.; Cao, A.; Huang, J.; Jiang, Z.; Lu, S.; Zang, S.Q. *App. Cat. B: Environmental*, **2022**, *316*, 121683.