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XIAO YU DISSERTATION DEFENSE
NanoEngineering Ph.D. Candidate
Cohen Research Group

"Development of Catalytic Metal-Organic Frameworks"

PI: Dr. Seth Cohen

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Abstract: MOFs have become a very active area of inorganic materials research. The high surface areas of MOFs have led to numerous studies of their use for different applications, including catalysis. MOFs have the potential to display significant advantages as catalysts over conventional heterogeneous catalysts. Features including high surface areas, large pore/cavity sizes, and the ability to modify design molecular-style catalysts within MOFs make these materials uniquely suited to achieve enzyme-like performance. The use of both pre- and post-synthetic methods to modify MOFs adds to the unique tunability of these materials.
This dissertation will discuss the catalytic applications of MOFs for organic transformations and as nanomotors. A series of catalytic MOFs were synthesized via different methods including prefunctionalization, postsynthetic modification, and postsythetic exchange. In the first two parts, different photocatalytic polypyridyl complexes have been successfully incorporated into MOF ligands to produce stable and reusable heterogenous catalysts. Organic reactions, including aerobic oxidations of arylboronic acids, and trifluoroethylation of styrenes are described in Chapters 2 and 3, respectively. In Chapter 4, a MOF with catalytic SBUs is investigated for its use in C-H amination chemistry, where it displays exceptional activity under mild conditions. Lastly, in Chapter 5, a relatively new area for catalytic MOFs, MOF micro- and nanomotors, will be described.