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## Design Nano Catalysts at the Atomic Level

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## Design Nano Catalysts at the Atomic Level

### Faculty Mentor

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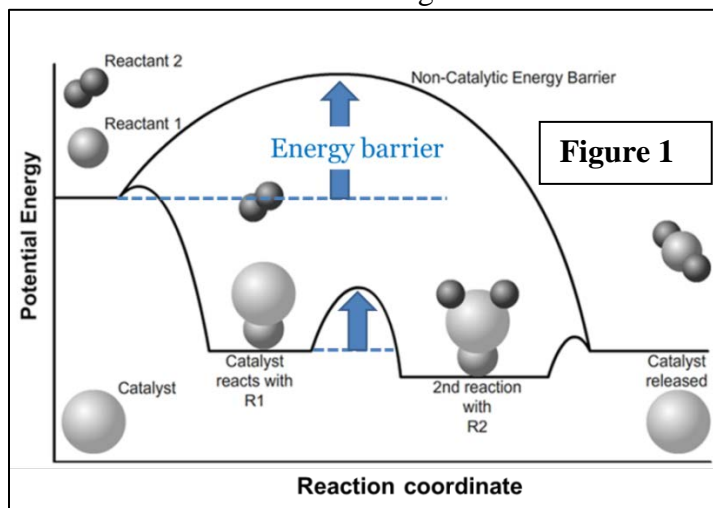
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### Project Summary

Catalysis (Figure 1) is the process that enables chemical reactions to produce the desired product at a much faster rate by using proper catalysts. It is the work horse of the chemical industry. It has been estimated that ~90% of worldwide commercial chemical processes utilize catalysts in one form or another in their daily productions, such as fuels, plastics, food, clean water, etc. New catalysts are increasingly in demand for environmentally friendly and energy efficient chemical processes. Design and development of nano catalysts will ultimately overcome the emerging energy, societal and environmental challenges.



We believe that substantial gains can be achieved by combining precise synthesis and state-of-the-art characterization techniques. New synthetic and stabilization methodologies, based on atomic layer deposition (ALD) will be developed for achieving highly active and stable catalysts. This technical allows us to design and synthesize nanostructured catalysts in an atom-by-atom fashion. Advanced techniques using one of the brightest artificial X-ray and Neutron beams at Department of Energy (DOE) national facilities will be employed to understand the catalyst active sites and local structure in real time under working conditions.

The research will integrate efforts in: 1) synthesis and stabilization of uniform, supported catalysts; 2) characterization of geometric and electronic structure of catalysts during synthesis; 3) investigation of catalytic and chemical events on the catalysts that are relevant to propylene oxide production. Student will be involved in the frontier research of material science and surface science and experience the state-of-the-art scientific equipment and techniques.

### Student Primary Responsibilities:

- Perform catalyst performance evaluation

- Record and analyze data using standardized forms and lab notebooks
- Assist in writing reports describing procedures used
- Assure all job activities adhere to UAH Environmental, Health and Safety requirements.

### **Qualifications**

- Major in chemical/mechanical/environmental engineering, chemistry, and physics
- Ability to work in a group setting
- Effective communication with the advisor and coworkers
- Strong computer capabilities including Microsoft Office

### **Physical Demands and Work Environment:**

- While performing the duties of this research it is required to stand, walk, and use hands to operate objects, tools, or controls; reach with hands or arms; climb, balance, stoop, kneel, or crouch when necessary for job activity.
- Must be able to lift and/or move up to 25 pounds.
- Specific vision abilities include: near, distance, peripheral, color perception, and the ability to adjust focus.
- Regularly works with moving mechanical parts and with toxic or caustic chemicals. The work may be performed in humid areas with low or high temperatures.

### **Mentor Supervision and Interaction**

Our multi-disciplinary research group currently consists of 6 graduate students, 4 undergraduate researchers and occasionally high school researchers during the summer. The RCEU undergraduate student will start their everyday research activities with one of the graduate students in the group. This does not reflect any lack of interest on my part in your project; it is rather an attempt to ensure that you will always have ready access to qualified, expert advice without necessarily having to hunt me down. It is also very important that graduate students have the opportunity to develop their own mentoring skills. Besides lab activities,

Individual Meeting. A definite schedule of individual meetings and team meetings is adopted weekly in our group. The group member will meet with the mentor in an informal fashion to discuss recent progress.

Group Meeting. Our group has joint weekly group meetings together with Professor Tingting Wu of Civil and Environmental Engineering Department. The perspective student will participate in the group meeting and be able to interact with graduate students and faculty members. He/She is expected to present in the group meeting.

### **Assessment**

The minimum requirement for the RCEU student is to at least present at UAH by the end of the program and submit their work to be published by the UAH undergraduate research journal –Perpetua. Previous undergraduate researchers in our group have been held against higher academic and scholar standards. Mr. Anderson White (BS, ChE, summa cum laude, 16') co-authored a peer-reviewed article published in a high impact journal in the field of nanotechnology (*Nanoscale*, 2016, vol. 8, page 15348-15356). Ms. Hayden Fowler (BS, ChE, 18') recently presented her research in the Southeast Catalysis Society annual meeting in Asheville, TN, in September 2016. We welcome ambitious and hard-working undergraduate researchers to join the group.