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**"Atomic Layer Deposition (ALD) is a Thin Film Deposition
Technique Widely Used in Microelectric Industry, Including IBM,
Intel, SamSung, etc.**

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Project Summary

Atomic layer deposition (ALD) is a thin film deposition technique widely used in microelectronic industry, including IBM, Intel, Samsung, etc. In the past 10 years, the global ALD market has increased 5 folds from ~\$ 200 million in 2005 to ~ \$ 1 billion in 2014. The great advantage of ALD is that it enables atomically precise coatings of thin film materials on complex objects. It employs self-limiting, sequential surface reactions, and therefore, it can achieve uniform coatings on the substrates as shown in Figure 1. The utilization of ALD permits the production of even more powerful portable microelectronic devices, such as smartphone, ipad, laptop, etc.

At UAH, we are interested in developing this state-of-the-art technique for the preparation of nanomaterials for green energy conversion and production. These materials include heterogeneous catalysts, lithium batteries, fuel cells and solar cells.

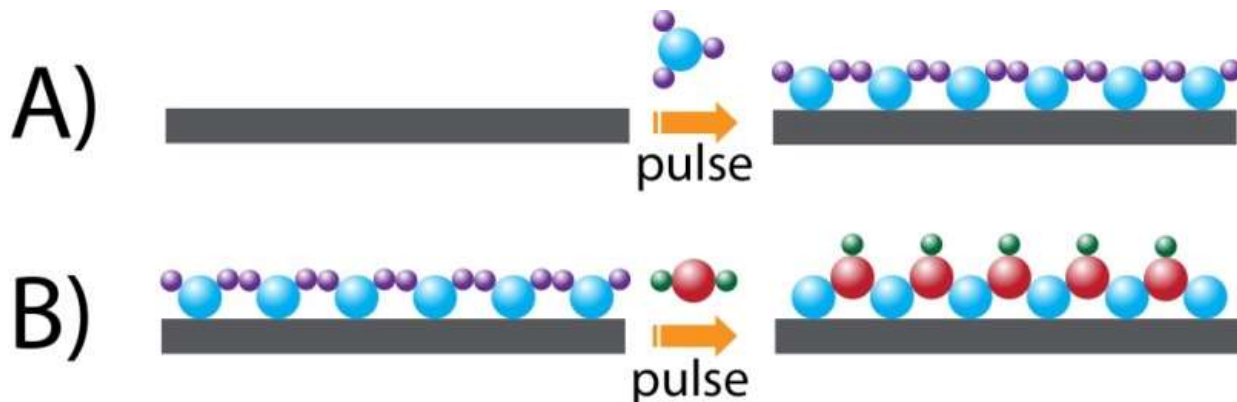


Figure 1. Schematic illustration of the Al₂O₃ ALD process. Alternating pulses of precursors required for atomic layer deposition of one monolayer.

The key for developing novel energy materials is to build the material structure/performance relationships. We will use this new synthetic methodologies, based on ALD and advanced characterization techniques using one of the brightest artificial X-ray and Neutron beams at Department of Energy (DOE) national facilities to understand the catalyst active sites and local structure in real time under working conditions.

Student Duties

Soak up as much knowledge as you can – provide enthusiasm in return.

This position prefers a student with knowledge of LabView visual programming software. The student will program new data acquisition interface for the ALD system and quartz crystal microbalance (QCM) under the supervision of the mentor. The new interface will allow

us to record operation parameters in real time, including pressure, temperature, precursor exposure time, and the film thickness. This will significantly improve the precision and efficiency of the synthesis and data acquisition system.

The perspective student is also expected to become familiar with the literature that is relevant to this project and with the wider literature in general.

There may be experiments scheduled in DOE national facilities during the summer. The student may have the opportunity to travel with the group to Argonne National Laboratory (Chicago, IL) and/or Oak Ridge National Laboratory (Oak Ridge, TN) to perform experiments. Information on our group field trip to Oak Ridge National Laboratory can be found on UAH Research News: http://www.uah.edu/news/research/uah-student-team-tests-catalysts-at-oak-ridge#.U5C-n_mwJFb.

In summary, this project will be a great multidisciplinary learning experience for developing scientific skills in the area of programming, equipment development, and nano-materials synthesis.

Mentor Supervision and Interaction

The perspective student is encouraged to see the mentor if there is anything he/she wants to discuss, science or otherwise.

Lab Visit. The mentor will work in the lab with students when it is necessary. This will allow students to have access to qualified, expert advice when it is needed.

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 weekly group meetings together with Professors George Nelson and Eunseok Lee of Mechanical and Aerospace Engineering Department. Each group meeting can be divided into two parts: literature survey and research progress. The perspective student will participate in our weekly group meeting and be able to interact with graduate students and faculty members. He/She will also present a literature survey in the area of ALD and nanotechnology during the summer. At the end of the summer, the student will present research progress that she has made during the period of this project at UAH.