UCLA Chemistry & Biochemistry

INORGANIC CHEMISTRY SEMINAR

Wednesday, November 14
3440 Mol Sci
3:30 p.m.

Inorganic Division
Department of Chemistry & Biochemistry
University of California, Los Angeles

DUAN RESEARCH GROUP

Chengzhang Wan, PhD candidate

Graphene based single atom water splitting catalysts

Abstract: Electrochemical single-atom catalysts (SACs) have recently attracted broad research interest as they combine the merits of both homogeneous and heterogeneous catalysts. Rational design and synthesis of SACs are of immense significance but have so far been plagued by the lack of the conductive substrate that can effectively hold and stabilize the single atoms. Taking the advantages of reduced holy graphene, we developed a general NH3 annealing approach for a series of monodispersed atomic transition metals (for example, Fe, Co, Ni) embedded in nitrogen-doped graphene with a common MN4C4 moiety which is identified by systematic X-ray absorption fine structure analyses and direct transmission electron microscopy imaging. The unambiguous structure determination allows density functional theoretical prediction of MN4C4 moieties as efficient oxygen evolution catalysts with activities following the trend Ni > Co > Fe, which is confirmed by electrochemical measurements. The furnace annealing approach is further replaced by 5 seconds microwave flash annealing to deliver a boost of single atom concentration by four times.

Dan Baumann, Grad Student

Covalent Triazine Frameworks for Energy Applications

Abstract: Covalent organic frameworks (COFs) are unique polymers with controllable pore sizes, high surface area, and a myriad of monomers to choose from. This makes them excellent candidates for energy storage applications. However, the conductivity of the majority of COFs is limited. Covalent triazine frameworks (CTFs) are a type of COF containing triazine motifs with high conductivity. This work revolves around the high temperature, ionothermal synthesis of CTFs in molten ZnCl2 with varying pore size distributions for use in supercapacitors and catalysis. Symmetric electric double layer capacitors (EDLCs) are made and tested with specific capacity values over 150 F/g at exceptional mass loadings over 10 mg/cm2. The heavy nitrogen content of the CTF allows for the chelation of metals atoms to the surface. This has the potential for various catalytic reactions. Preliminary results for the hydrogen reduction reaction (HER) activity is accessed for these materials.

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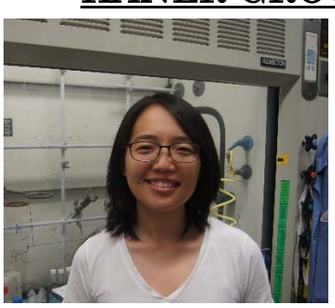

Wai Mak, Grad Student

Compressible Flow Exfoliation of Layered Materials

Abstract: Nanostructured materials are becoming increasing popular due to its enhanced properties compared to their bulk counterparts. As the demand of new materials grow, large scale and high throughput syntheses must be devised with particular attention to green synthetic methods. Two-dimensional layered materials can be synthesized through the bottom-up or top-down approach. Examples of top-down approach includes liquid and mechanical exfoliation which takes advantage of weak Van der Waals forces of layered materials. Compared to solution based syntheses, solid state reactions through mechanochemical route can provide less waste generation. We have designed a gas phase exfoliation method to delaminate bulk boron nitride, molybdenum disulfide, and graphite into few-layered sheets. This process relies on the formation of supersonic flow and shear forces. Compared to other top-down approaches, gas phase exfoliation decreases processing time from hours to seconds. The resulting materials were characterized using transmission electron microscopy, ultraviolet-visible spectroscopy, atomic force microscopy, and Raman spectroscopy. The results from this study pave the way for realizing scalable and efficient methodologies for exfoliation of layered materials.