INORGANIC CHEMISTRY SEMINAR

DUAN RESEARCH GROUP

Wang Xue, PhD candidate

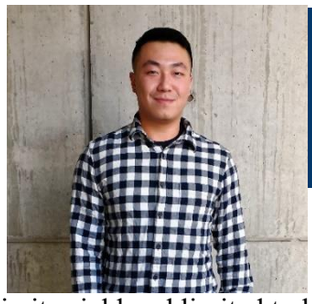
Platinum based ternary PtCuCo catalyst for methanol oxidation reaction.

Abstract: Fuel cells that can directly converts clean chemical fuels into electricity is a promising technology for clean energy utilization. Methanol is an attractive fuel for fuel cells for its high energy density, low cost and convenience in storage and transportation. However, the electrocatalytic methanol oxidation reaction (MOR) is generally sluggish with high over potential and requires costly precious metal (e.g., platinum), yet still with low activity and poor durability. In this talk, I will discuss the design and synthesis of ternary PtCuCo nanocatalyst that can significantly enhance the MOR activity and stability. Systematic studies reveal that alloying platinum with copper helps lower the d-band center of platinum, leading to the weakened Pt-CO bonding strength, and hence increasing the activity. Additionally, cobalt can help to decrease the dissolution of platinum and copper, leading to considerably improved stability. Together, the optimized composition of $Pt_{38}Cu_{39}Co_{23}$ exhibits the highest MOR specific activity and stability among the state-of-the-art MOR catalysts.

Dan Zhu, PhD candidate

Tailoring Interface Chemistry for Efficient Lithium Ion Transport in Silica Aerogel/Polymer Composites

Abstract: Lithium metal battery is promising for ultrahigh density energy storage,but is plagued by lithium-dendrite formation and risk of catastrophic failure. Solid electrolytes can mitigate the risk of lithium-dendrite penetration due to having higher Young's modulus than conventional separators. However, solid electrolytes are generally limited by insufficient ionic conductivity. This study investigates the interface chemistry to tailor the ionic transport in a silica aerogel/polymer composite. In this design, lithium trifluoromethane-bis-(sulfonyl)imide (LiTFSI) surface functionalized silica aerogel/polyethylene oxide (PEO) composite was made. The functionalized composite electrolyte shows greatly improved lithium ionic conductivity. We further show the composite exhibits attractive ion transport properties in the overlooked low temperature regime. This study opens a new avenue to tailor interface chemistry in solid state composite electrolytes for high ionic conductivity.



Frank Song, PhD candidate

Electrochemical Exfoliation of Layered Crystals for Electronic Inks

Abstract: Two-dimensional (2D) atomically thin nanosheets have generated tremendous interests for electronic applications such as transistors and sensors. Micromechanical cleavage using adhesive tape to acquire nanosheets isinadequate in its yield and limited to laboratory studies. Solution-processed methods for obtaining nanosheets offers a practical pathway to the scalable production of high-quality 2D materials. This talk discusses a novel strategy to exfoliate nanosheets from their bulk layered crystals. Using molybdenite (MoS_2) as the cathode in an electrochemical cell setup, quaternary ammonium cations (NR_4^+) are intercalated to weaken the interlayer van der Waal interaction. The intercalated MoS2 could then easily be exfoliated and stabilized in solution creating a colloidal ink of 2D nanosheets. The nanosheet ink was deposited onto a variety of substrates to form high quality electronic thin films through a low temperature solution process. Finally, we demonstrate that it is possible to produce a library of colloidal nanosheet inks by growing and exfoliating a family of layered crystals. This opens new possible applications utilizing 2D nanosheets in the fields of large-area and flexible electronics.

Wednesday, March 4th 2020

3440 Mol Sci

4:00 p.m.

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