AY2015 UROP PROJECTS

School of Materials Science & Engineering

PROJECTS OFFERED BY ASSOC. PROF KONG LING BING

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Conductive Nanocomposites as Electrode Materials

A new type of conductive nanocomposites will be developed, for potential applications as electrodes in energy storages. These materials can be used to construct flexible energy storage devices, such as supercapaticors and lithium-ion batteries.

New Method to Synthesize Nanosized Oxides

A new method will be developed to synthesize nanosized oxides in a simple and fast way. The synthesized oxides could be used as gas sensors and electrode materials for energy storage. Students will be trained in materials processing and characterization (such as XRD, SEM, etc).

Development of Transparent Ceramics for Multiple Applications

Transparent ceramics have found various applications in laser, IR and armors. This project will involve key techniques used to fabricate transparent ceramics. Selected materials will be studied to show how to make transparent ceramics.

PROJECT OFFERED BY ASST. PROF LI SHUZHOU

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Nanoparticle Assembly in Water

Nanoparticles always show unique optical, chemical, and electrical properties. These functional nanoparticles need to be assembled in large area to form functional materials. This project will investigate nanoparticle assembly in water by molecular dynamics simulations. By tuning the interactions between nanoparticles, various functional materials can be obtained.

PROJECT OFFERED BY
ASSOC. PROF ANDREW GRIMSDALE

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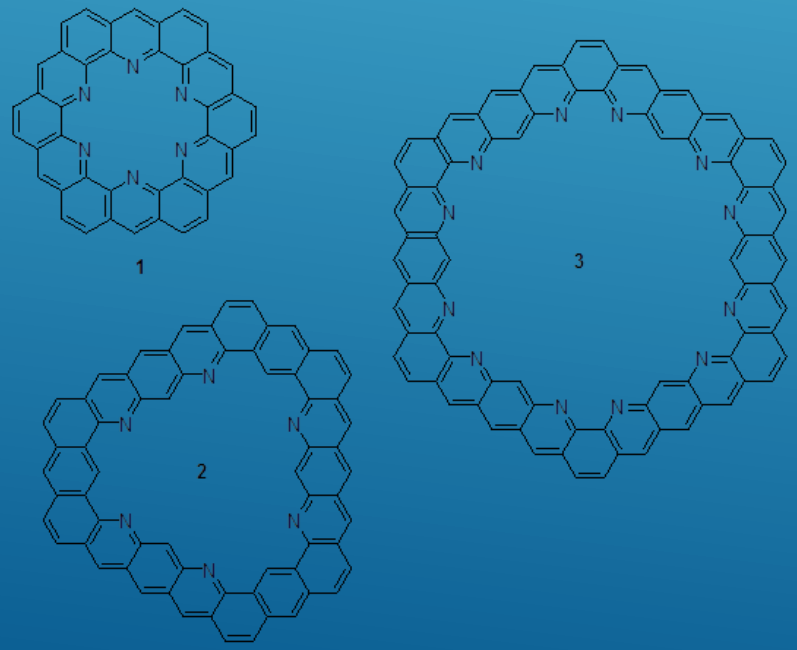
Towards Conjugated Macrocyclic Polyarenes

Macrocyclic conjugated molecules are a little studied class of materials with potentially very interesting properties. The project involves synthesis of intermediates towards the synthesis of cyclic molecules such as hexazakekulene **1** and of larger macrocycles such as **2** and **3**.



The student will be required to perform synthesis and characterization of organic molecules using spectroscopy under the mentorship of Prof Grimsdale's PhD student.

Interested student please make an appointment with Prof Grimsdale.

PROJECT OFFERED BY ASSOC. PROF SU HAIBIN

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Modeling Electrochemical Devices

Electrochemical devices for energy storage and conversion, such as batteries and fuel cells, are called to play a key role in the development of sustainable energetic networks worldwide. These clean electric power devices offer a large spectrum of applications such as in portable electronics, transportation and stationary. Development of stable and inexpensive materials and components is the most important technological challenge that nowadays battery and fuel cell developers are facing. Deep insight based on physical modeling of the materials behaviour and aging will advise us how these components with optimal specifications could be made and how they can be integrated into operating devices.

Research Area:

Two-dimensional Materials Design and Application

Nanyang Assistant Professor Zheng LIU

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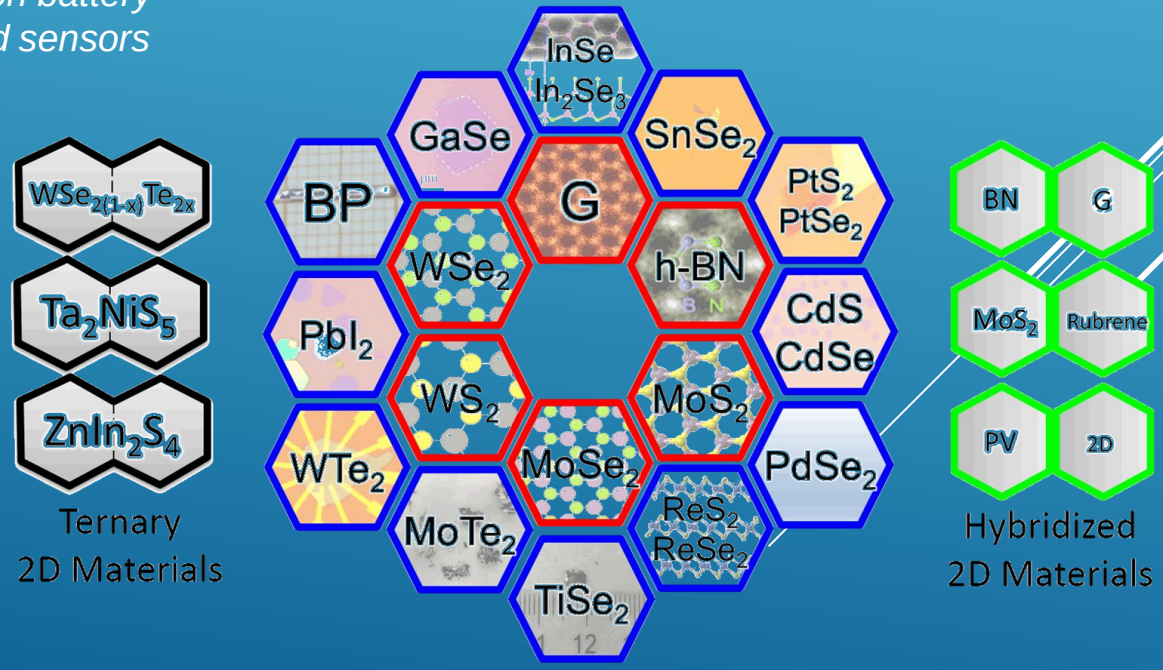
Principal Interests and Expertise:

- *Synthesis of Novel 2D Materials & their Heterostructures*
- *Smart films: High performance coating, Pollution control*
- *Electronics: Wearable electronics, Pressure sensors*
- *Energy: Supercapacitors, Water splitting & lithium ion battery*
- *Optics: Light detector/harvester, Polarization/Infrared sensors*

Representative Papers:

- Nature Communications 2014, 5, 5246
- Nature Materials 2014, 13, 1135
- Nature Communications 2014, 5, 3782
- Nature Communications, 2014, 5, 319
- Nature Communications, 2013, 4, 2541
- Nature Materials 2013, 12, 754-759
- Nature Nanotechnology 2013, 8, 119
- Nature communications 2012, 3, 879
- Nature Nanotechnology 2011, 6, 496

2D Materials Collection Prepared in Our lab



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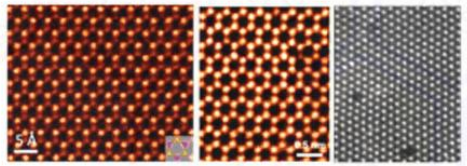
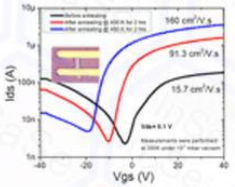


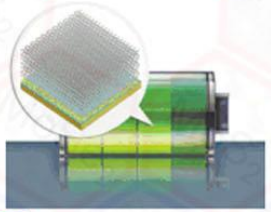
Fundermental Research

- *Growing mechanism*
- *Ferromagnetism*
- *Superconductor*
- *Phase transition*
- *Light-matter interaction*



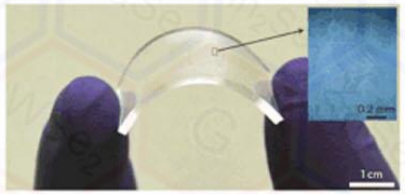
Electronics

- *Wearable electronics*
- *Pressure sensors*
- *High-density storage*



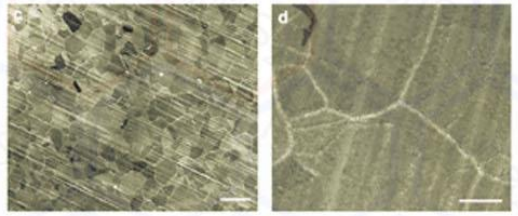
Energy

- *2D materials based supercapacitors*
- *Water Splitting (HER)*
- *Lithium ion battery*



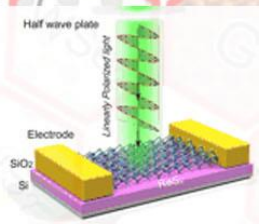
Smart Films

- *High-temperature anti-oxidation coatings*
- *petroleum pollution control*
- *Flexible composites*



Thermal applications

- *2D thermoelectric materials;*
- *Thermal management*



Optical devices

- *Polarization detector*
- *Infrared sensors*
- *Light harvester*