



**Seminar Topic:  
Flatland: The Landscape of 2D Materials**

**Nanyang Assistant Professor Liu Zheng**

### Abstract

The one-atom-thick crystal – graphene has fantastic properties and has attracted tremendous interests in recent years, which has opened a window to the landscape of two-dimensional (2D) materials. There is a large variety of 2D materials beyond graphene which can be explored. Using solid state chemical reactions and chemical vapour deposition, we have successfully synthesized a wide spectrum of 2D materials (both single crystals and few layers).

In this talk, I will briefly introduce the development of 2D materials over the past 10 years and our recent work in this area, including the advances in the synthesis and engineering of various 2D materials, such as design of lateral and vertical 2D heterostructures and fabrication of 2D alloys. We will also discuss the unique physical properties, such as 2D superconductivity ( $\text{MoTe}_2$  and  $\text{NbSe}_2$ ), 2D ferroelectricity ( $\text{CuInP}_2\text{S}_4$ ), 2D ferromagnetism and 2D Wyle semi-metals, as well as the potential applications of 2D materials in the fabrication of novel electronics, detectors, sensors, coatings and composites, energy and catalysis.

### Biography

Dr Liu Zheng received his B.S. degrees from Nankai University (China) in 2005, and completed his Ph.D at the National Centre for Nanoscience and Technology (NCNST, China), working on the synthesis of carbon nanotubes for energy harvesting. Subsequently, he joined the groups of Professor Pulickel M. Ajayan and Professor Jun Lou as a joint postdoctoral research fellow (2010 – 2012) and research scientist (2012 – 2013) at Rice University (USA).

His research focuses on the following topics: 1) Synthesis of novel, high quality and large-sized 2D monolayers, especially, a full spectrum of transition metal dichalcogenides (TMDs) – the biggest family ever known in 2D materials; 2) Engineering of 2D materials, such as lateral/vertical 2D heterostructures and alloys; 3) Physical properties of 2D monolayers, such as 2D superconductivity ( $\text{MoTe}_2$  and  $\text{NbSe}_2$ ), 2D ferroelectricity ( $\text{CuInP}_2\text{S}_4$ ), 2D ferromagnetism and 2D Wyle semi-metals ( $\text{W}_x\text{Mo}_{1-x}\text{Te}_2$  and  $\text{TaIrTe}_4$ ); 4) Applications of 2D materials, such as novel electronics (semi-floating gate FET, inorganic/organic P-N junction and rectifier, ferro-electrically non-volatile memory), detectors and sensors (atom-thin photodetector, photoconductive switch and microelectromechanical sensor), coatings and composites (high temperature oxidation-resistant coating, binder-free fire-resistant wood coating), energy and catalysis (Li-ion battery, supercapacitor, ORR, HER, etc).

Dr Liu Zheng has published more than 140 peer-reviewed papers in top journals, including 16 papers in Nature and Science series (**Nature Materials**, **Nature Nanotechnology**, **Nature Communications and Science Advances**), 22 papers in **Nano Letters**, 17 papers in **Advanced Materials**, 9 papers in **ACS Nano**, with a **total citation of more than 11,000 and a h-index of 47**. His work has been reported by the media, such as **Science Daily**, **Phy.org**, **EEE Spectrum**, etc., and also highlighted by top journals, such as **Nature Physics**, **Nature Nanotechnology**, **Chem Int Ed**, etc. He was a recipient of the **World Technology Award in Energy** in 2012, which is given to honour those doing “the innovative work of the greatest likely long-term significance.” In addition, he was awarded the prestigious Singapore NRF Fellowship and the elite Nanyang Assistant Professorship.

**Wednesday, 15 November 2017 || Time: 2:00 pm – 3:00 pm**  
**Venue: MSE Meeting Room (N4.1-01-28)**  
**Hosted by: Assistant Professor Yu Jing**