

## Abstract

As the Moore's law is running into its physical limit, it requires the exploration of novel materials to enable "More Moore" and "More than Moore", according to the projection of International Roadmap of Technology for Semiconductor (ITRS) 2.0. The atomic-level thickness makes two-dimensional (2D) layered materials immune to the short-channel effect, providing the potential for future scaling. The ultralarge surface-to-volume ratio of 2D materials allow them to respond external stimuli with high sensitivity, not only for electronic signal but also optical, electrochemical, thermal or even biological stimuli.

In this talk, I will first introduce our work about the use of graphene as the barrier of the Cu interconnect to replace conventional TaN barrier.<sup>1</sup>Our experimental and computational results show that graphene barrier can meet the ITRS requirement. We also perform a systematic study on the physical properties and electronic transport of group-10 transition metal dichalcogenides (TMDs).<sup>2,3</sup>The strong interlayer interaction and the dramatic change of bandgap with the layer number show the potential applications of group-10 TMDs in field-effect transistors and infrared photodetectors. The molecules with the unlimited degree of freedom in structure design can provide diverse functionalities for 2D devices. Recently, we realize novel light-responsive 2D electronics based on hybrid molecule/2D system.<sup>4</sup>The devices can function as optically controlled transistors, multibit optical memories, and light-tunable diodes.

1 Zhao, Y. et al. Mass Transport Mechanism of Cu Species at the Metal/Dielectric Interfaces with a Graphene Barrier. *ACS Nano* 8, 12601-12611 (2014).

2 Zhao, Y. et al. Extraordinarily Strong Interlayer Interaction in 2D Layered PtS<sub>2</sub>. *Adv. Mater.* 28, 2399-2407 (2016).

3 Zhao, Y. et al. High-Electron-Mobility and Air-Stable 2D Layered PtSe<sub>2</sub> FETs. *Adv. Mater.* 29, 1604230 (2017).

4 Zhao, Y., Bertolazzi, S. & Samorì, P. A Universal Approach toward Light-Responsive Two-Dimensional Electronics: Chemically Tailored Hybrid van der Waals Heterostructures. *ACS Nano* 13, 4814-4825 (2019).

## Biography:

Dr. Yuda Zhao obtained his bachelor's degree from Nanjing University, China in 2012 and got his PhD degree from the Hong Kong Polytechnic University in 2016. Currently, he is a postdoctoral researcher (Marie Curie Individual Fellow) at the University of Strasbourg, France. His research interest focuses on the physical properties of 2D materials, the functionalization of 2D materials by molecular approach and their application in electronic and optoelectronic devices.