# Black phosphorus ink formulation for inkjet printing of optoelectronic devices

With the support by the National Natural Science Foundation of China, the collaborative research by an international team led by Dr. Tawfique Hasan from the University of Cambridge (UK), Assoc. Prof. Zhang Meng from Beihang University (China), and Prof. Xu Yang (徐杨) and Asst. Prof. Khurram Shehzad from Zhejiang University (China), has made a technological breakthrough by developing inks made of graphene-like materials for inkjet printing of cutting-edge electronics which was published in *Nature Communications* (2017, 8: 278).

Black phosphorous (BP) is a new graphene-like two-dimensional nanomaterial which holds promise for a great number of electronic applications. However, until now its potential has been limited due to difficulties in its processing arising from its high environmental instability. Authors of this research claim to have solved the problem by processing the nanometer thick layers of BP into an environmentally stable ink that can be reliably inkjet printed on a variety of substrates to fabricate optoelectronic and photonic devices.

BP ink formulation and the demonstrated device performance from Prof. Xu and his colleagues highlights the potential for printed BP in a broad range of long-term stable optoelectronic and photonic systems even when operating under ambient conditions. Printability of BP onto a variety of substrates will further broaden its scope of applications. For example, when printed on Si, it was used to make transistors or photodetectors. By printing it on plastic or transparent glasses, they fabricated wearable medical sensors, or transparent devices, respectively.

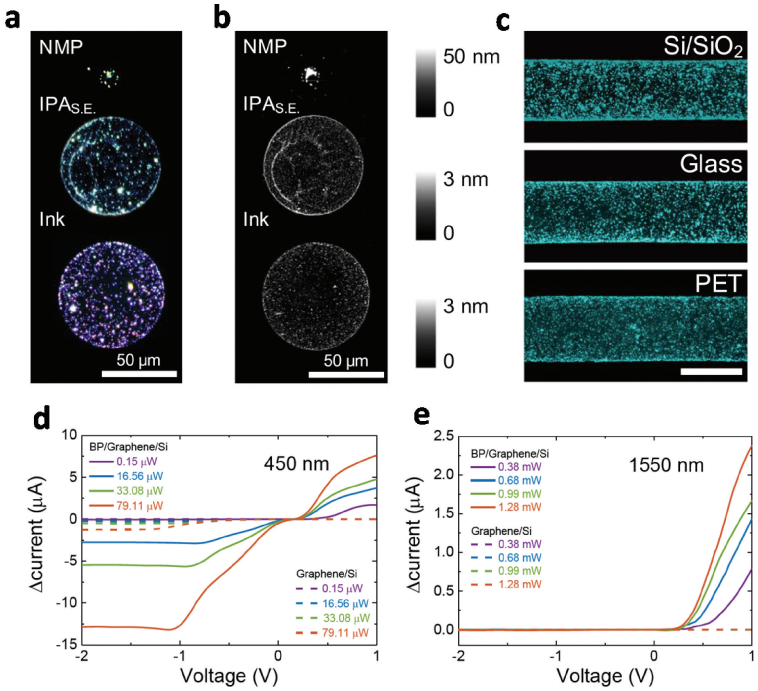


**Figure** (a, b) Optical micrographs and AFM images of the dried BP droplets. (c) Optical micrographs of optimized printed tracks on $Si/SiO_2$ glass and PET. (d, e) Associated current response for response of the BP/graphene/Si Schottky photodetector

This work is part of a larger project carried out by Prof. Xu and his team aiming to develop strategies to combine the detection capabilities of two-dimensional materials with Si CMOS technology to fabricate high performance UV & IR photodetectors. Recently, they also made several other important advances in this regard (*Adv. Mater.*, 2017, 29: 1700463; *Adv. Mater.*, 2016, 28: 4912; *NPJ 2D Mater. Appl.*, 2017, 1: 4; *ACS Nano*, 2016, 10: 4895; *ACS Nano*, 2017, 11: 9854; *Adv. Mater. Technol.*, 2017, 2: 1600241; *Chem. Soc. Rev.*, 2016, 45: 5541). Their work was supported by the National Natural Science Foundation of China, Zhejiang Province Natural Science Foundation Project, Fundamental Research Funds for the Central Universities, micro/nano-fabrication platform of Zhejiang University, and China Scholarship Council (Ayaz Ali).