Air stable n-type black phosphorus transistor with photoactive doping layer

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Abstract

Black phosphorus (BP) is usually a p-type semiconductor with hole mobility of its device range from 100$cm^2V^{-1}s^{-1}$ to 300 $cm^2V^{-1}s^{-1}$ and on/off ratio up to 10^5. However, BP is very sensitive to the environment and its outstanding properties will fade away in a short time under moisture and oxygen exposure.
In this presentation, a novel approach to demonstrate tunable transport properties of a few-layered BP field-effect transistor (FET) device with extended air stability will be proposed. With Titanium suboxide (TiOx) thin film applied on BP surface we can not only improve its air stability but also provide tunable n-type doping on BP through light illumination which can modify the transport properties of BP from the intrinsic hole-dominated transport to the electron-dominated transport. With controllable transport properties on channel, this novel device structure of BP exhibit great potential for the future development of logic devices or optoelectronic devices.[1]

References

[1] P.H. Ho et al., ACS photonics, Vol.3 issue6 (2016) pp1102–1108

Figures

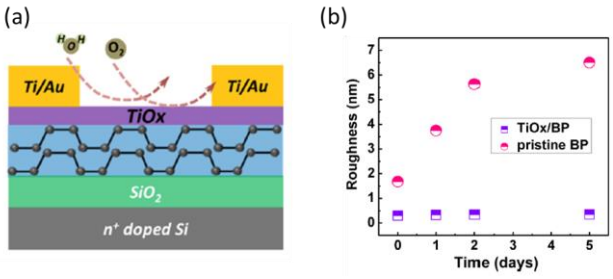

Figure 1: (a) Schematic representation of a BP FET with precoated TiOx layer. (b) Time-dependent evolution of surface roughness of BP with and without coating TiOx film.

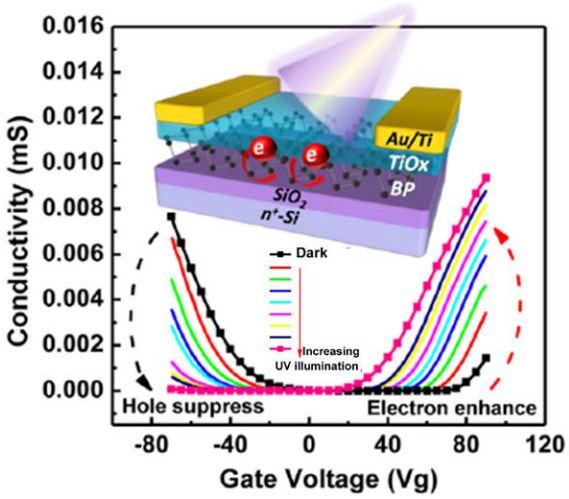

Figure 2: Evolution of conductivity versus gate-voltage curves for the TiOx/BP FET with increased irradiation time. The inset is the schematic representation of a BP/TiOx transistor under illumination