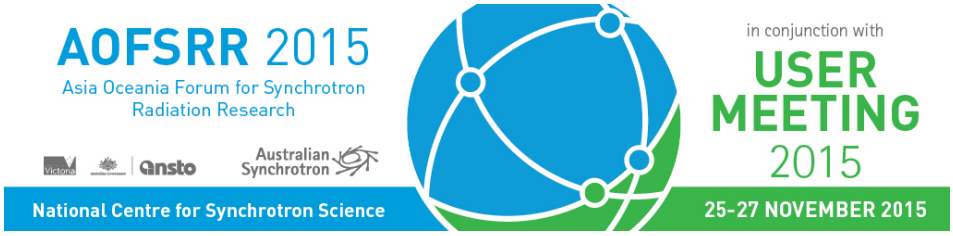

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Creating a Stable Oxide at the Surface of Black Phosphorus

Friday, 27 November 2015 13:30 (45)

The stability of the surface of in-situ cleaved bulk black phosphorus single crystals upon exposure to atmosphere is investigated using high-resolution synchrotron x-ray photoelectron spectroscopy and atomic force microscopy. We demonstrate that after 2 days exposure to atmosphere a stable 0.35nm thick phosphorus oxide forms at the surface of the black phosphorus. Three types of local phosphorus–oxygen environments are identified, and it is found that the majority of the oxide consists of phosphorus pentoxide (P2O5), which represents the most thermodynamically favourable oxidation pathway. The work function increases from 3.9 eV for as-cleaved black phosphorus to 4.0eV after formation of the 0.35 nm thick oxide, with the phosphorus core levels shifting by less than 0.1 eV. These results indicate minimal charge transfer between the oxide and the underlying black phosphorus layers.We conclude that the native oxide formed on black phosphorus is a stable passivation layer with minimal effect on the doping of black phosphorus. The native oxide is also potentially attractive for the subsequent deposition of additional dielectric layers in order to fabricate metal-oxide-semiconductor field-effect structures

Keywords

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