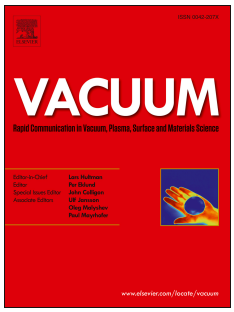
Accepted Manuscript



Electric-field tunable electronic properties and Schottky contact of graphene/ phosphorene heterostructure

Huynh V. Phuc, Victor V. Ilyasov, Nguyen N. Hieu, Chuong V. Nguyen

PII: S0042-207X(17)31034-5

DOI: 10.1016/j.vacuum.2017.12.040

Reference: VAC 7746

To appear in: *Vacuum*

Received Date: 2 August 2017

Revised Date: 21 November 2017

Accepted Date: 28 December 2017

Please cite this article as: Phuc HV, Ilyasov VV, Hieu NN, Nguyen CV, Electric-field tunable electronic properties and Schottky contact of graphene/phosphorene heterostructure, *Vacuum* (2018), doi: 10.1016/j.vacuum.2017.12.040.

Electric-field tunable electronic properties and Schottky contact of graphene/phosphorene heterostructure

Huynh V. Phuc [a], Victor V. Ilyasov [b], Nguyen N. Hieu [a], Chuong V. Nguyen [c,*]

[a] *Institute of Research and Development, Duy Tan University, Da Nang, Viet Nam*

[b] *Department of Physics, Don State Technical University, Rostov on Don, Russia*

[c] *Department of Materials Science and Engineering, Le Quy Don Technical University, Ha Noi, Viet Nam*

Abstract

In this paper, we study the electronic properties of graphene/phosphorene (G/P) heterostructure under applied electric field. The interlayer distance between graphene and topmost phosphorene is 3.50 Å and the binding energy per carbon atom is 28.2 meV, which is indicated that graphene is bound to phosphorene via vdW interaction. The appearance of an energy gap of 33 meV in graphene is due to the dominant influence exerted by the phosphorene on graphene and sublattice symmetry broken between graphene and substrate. The G/P heterostructure forms a *p*-type Schottky contact with Φ_{Bp} = 0.34 eV. By applying the negative electric field, the G/P heterostructure keeps a *p*-type Schottky contact. Whereas with the positive electric field of $E \geq$ +0.25 V/Å, Φ_{Bp} becomes larger than Φ_{Bn}, resulting in a transformation from p-type to *n*-type Schottky contact. The present results may open up a new avenue for application of the G/P vdW heterostructure in electronic devices.