LOW-SYMMETRY TWO-DIMENSIONAL STRUCTURES WITH ANISOTROPIC HIGH CARRIER MOBILITY

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A strong in-plane anisotropy of carrier transportation was found in black phosphorene [1], which provides another degree of freedom for tuning the physical properties of 2D materials and thus expands the range of opportunities for designing novel 2D semiconductors with unique applications. By combine graphene and black phosphorene, a series of previously unknown allotropes of phosphorus carbide (PC) in the stable shape of an atomically thin layer have been predicted [2]. As a result of the competition between sp^2 bonding found in graphitic C and sp^3 bonding found in black P, the PC structures can display as semi-metals with an anisotropic Dirac cone, or narrow-gap semiconductors with a strong anisotropic high carrier mobility. The relatively narrow band gaps of semiconducting PC structures can be further tuned by the approach of isoelectronic substitution. Previous unknown novel low-symmetry 2D ternary 2D structures have been designed. Sharing the geometry of 2D PC, the predicted 2D ternary structures display a strong in-plane anisotropy together with band gaps covering a wider range and broader the potential of applications in the novel nano-devices.

References

[1] Liu, H.; Neal, A. T.; Zhu, Z.; Luo, Z.; Xu, X.; Tománek, D.; Ye, P. D., ACS Nano 2014, 8, 4033-4041.

[2] Guan J., Liu D., Zhu Z., Tománek D., Nano Lett. 2016, 16, 3247.