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Nano-scale displacement sensing based on van der Waals interaction.[1] LIN HU, Beijing Computational Science Res Ctr, UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA COLLABORATION — We propose that a nano-scale displacement sensor with high resolution for weak-force systems can be realized based on vertically stacked two-dimensional (2D) atomic corrugated layer materials bound through van der Waals (vdW) interactions. Using first-principles calculations, we found that the electronic structure of bi-layer blue phosphorus (BLBP) vary appreciably with the lateral and vertical interlayer displacements. The variation of the electronic structure due to the lateral displacement is attributed to the change in the interlayer distance d_z induced by atomic layer corrugation, which is in a uniform picture with vertical displacement. Despite the different stacking configurations of BLBP, we find that the change of the indirect band gap is proportional to d_z^{-2}. Further, this d_z^{-2} dependence is found to be applicable to other graphene-like corrugated bi-layer materials such as MoS_2. BLBP represents a large family of bi-layer 2D atomic corrugated materials for which the electronic structure is sensitive to the interlayer vertical and lateral displacement, and thus could be used for nano-scale displacement sensor. This can be done by monitoring the tunable electronic structure using absorption spectroscopy.

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