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Phosphorene Nanoribbons: Electronic Structure and Electric Field Modulation[1] SINA SOLEIMANIKAHNOJ, IRENA KNEZEVIC, University of Wisconsin Madison — Phosphorene, a newcomer among the 2D van der Waals materials, has attracted the attention of many scientists due to its promising electronic properties. Monolayer phosphorene has a direct band gap of 2 eV located at the Gamma point of the Brillouin zone. Increasing the number of layers reduces the bandgap due to the van der Waals interaction. The direct nature of the bandgap makes phosphorene particularly favorable for electronic transport and optoelectronic applications. While multilayer phosphorene sheets have been studied, the electronic properties of their 1D counterparts are still unexplored. An accurate tight-binding model was recently proposed for multilayer phosphorene nanoribbons. Employing this model along with the non-equilibrium Greens function method, we calculate the band structure and electronic properties of phosphorene nanoribbons. We show that, depending on the edge termination, phosphorene nanoribbons can be metallic or semiconducting. Our analysis also shows that the electronic properties of phosphorene nanoribbons are highly tunable by in-plane and out-of-plane electric fields. In metallic ribbons, the conductance can be switched off by a threshold electric field, similar to field effect devices.

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sina soleimanikahnoj
University of Wisconsin Madison

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