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Black Phosphorus/Phosphorene and Beyond¹

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Black phosphorus (BP) and its monolayer form phosphorene have been intensively studied due to its layered structure, high mobility, direct bandgap, and have great potentials in optical and electronic applications. In this talk, we review the rapid progress in the field, in particular, the recent demonstration of high performance BP transistors with drain current approaching 1A/mm with BN/Al₂O₃ top gate and the observation of the negative Poisson's ratio under strain due to its unique puckered atomic structures. Air stability of BP/phosphorene is still a big concern for application driven research, although great efforts and significant progress have been made by BN and/or Al₂O₃ passivation in controlled environment. Here, we also introduce a new van der Waals material which has high mobility, direct bandgap as BP/phosphorene plus its excellent air stability. Fundamental studies of its transport, optical, and mechanical properties will be presented. We acknowledge the close and fruitful collaborations with AFRL, TSMC and Prof. Xu, Prof. Lundstrom, Prof. Wu's groups at Purdue University.

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