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Black Phosphorus RF Transistor HAN WANG, Ming Hsieh Dept. EE, USC, XIAOMU WANG, FENGNIAN XIA, Dept. EE, Yale, LUHAO WANG, Ming Hsieh Dept. EE, USC, HAO JIANG, QIANGFEI XIA, Dept. ECE, U Mass, MATTEW L. CHIN, MADAN DUBEY, Sens & Elec. Dev. Directorate, US ARL, SHU-JEN HAN, IBM T.J. Wason Cent. — Few-layer and thin film form of layered black phosphorus (BP) has recently emerged as a promising material for applications in high performance thin film electronics and infrared optoelectronics. Layered BP offers a $\sim$ 0.3eV bandgap and high mobility, leading to transistor devices with decent on/off ratio and high on-state current density. Here, we demonstrate the GHz frequency operation of black phosphorus field-effect transistor for the first time. BP transistors demonstrated here show excellent current saturation with an on-off ratio exceeding 2×10^3. The S-parameter characterization is performed for the first time on black phosphorus transistors, giving a 12 GHz short-circuit current-gain cut-off frequency and 20 GHz maximum oscillation frequency in 300 nm channel length devices. A current density in excess of 270 mA/mm and DC transconductance above 180 mS/mm are achieved for hole conductions. The results reveal the promising potential of black phosphorus transistors for enabling the next generation thin film transistor technology that can operate in the multi-GHz frequency range and beyond.

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