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**Toward Air-Stable Multilayer Phosphorene Thin-Films and Transistors**[1] JOON-SEOK KIM, YINGNAN LIU, WEINAN ZHU, SEOHEE KIM, DI WU, LI TAO, ANANTH DODABALAPUR, KEJI LAI, DEJI AKINWANDE, The University of Texas at Austin — Few-layer black phosphorus, also known as phosphorene, has recently rose into scientific limelight due to its promising characteristics for flexible device and optoelectronic applications, such as high mobilities beyond what is achievable in other 2D dichalcogenides. In addition, its direct thickness-dependent bandgap enables optoelectronics from the infrared to visible regions. However, a fundamental challenge lies on its lack of air stability, which is of paramount importance for practical device application. Physical degradation of unprotected phosphorene in a matter of hours in air was obvious from optical and atomic force microscopy (AFM). Moreover, microwave impedance microscopy (MIM) revealed that samples with thin capping layers, though more air-stable, began to degrade from the edges inward within a few days, where the degradation was primarily electronic with minor physical changes. Statistics from phosphorene field-effect transistors (FETs) have shown that double capping with dielectric and hydrophobic fluoropolymer films afford further improved and robust weeks-long air-stability. The simple capping methods represent a facile route for achieving air-stable phosphorene devices that can enable basic studies and potential applications.

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