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Asymmetric capacitance and ambipolar metal insulator transition in black phosphorus YU SAITO, YOSHIHIRO IWASA, Quantum-Phase Electronics Center (QPEC) and Department of Applied Physics, The University of Tokyo, Japan — Black phosphorus is a van der Waals type semiconducting layered material with a puckered honeycomb structure where each phosphorus atom is covalently bonded with three adjacent phosphorus atoms and has a direct band gap of 0.3 (bulk) - 2 (monolayer) depending on the number of layers [1], which can be promising material for optoelectronics devices such as photodetector. In this presentation, by using ionic liquid gating method, we report the ambipolar transistor operation and the field effect controlled ambipolar metal-insulator transition in black phosphorus thin flake. We observed a large modulation of the sheet resistance by more than 4 orders of magnitude in both electron channel and hole channel. These results suggest black phosphorus will be a key material for not only understanding physics of the conduction channel produced by ionic gating, but also potential functions including formation of p-n junction and therefore lateral tunnel diode utilizing intrinsic narrow band gap.

[1] Li et al, Nature Nanotechnology, 9, 372 (2014)

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