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Tantalum Disulfide Ionic Field-Effect Transistors YIJUN YU, FANGYUAN YANG, Fudan University, XIU FANG LU, YA JUN YAN, University of Science and Technology of China, Y. H. CHO, Rutgers University, LIGUO MA, XIAOHAI NIU, Fudan University, SEJOONG KIM, YONG-WOO SON, Korea Institute for Advanced Study, DONGLAI FENG, SHIYAN LI, Fudan University, SANG-WOOK CHEONG, Rutgers University, XIAN HUI CHEN, University of Science and Technology of China, YUANBO ZHANG, Fudan University — The ability to tune material properties using gate electric field is at the heart of the modern electronic technology. Electrolyte gating has recently emerged as an important technique to reach extremely high surface charge carrier concentration in a variety of materials through the formation of electric double layer (EDL) at the sample surface. Here we demonstrate a new mechanism of electrolyte gating that modulates the volumetric carrier density by gate-controlled intercalation in layered materials. We fabricate field-effect transistors (referred to as ionic field-effect transistor, iFET) based on transition metal dichalcogenides 1T-TaS_2 and 2H-TaS_2. The unprecedented large doping induces dramatic changes in the transport properties of the sample, including CDW phase transitions, superconductivity and metal-to-insulator transitions. The controllable and reversible intercalation of different ion spices into layered materials opens up new possibilities in searching for novel states of matter in the extreme charge-carrier-concentration limit.

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