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High performance unipolar $MoTe_2$ field effect transistors enabled by doping and Al_2O_3 capping [1] DESHUN QU, XIAOCHI LIU, FAISAL AHMED, WON JONG YOO, Sungkyunkwan Univ — We carry out the first systematic experiment on carrier type modulation of $MoTe_2$ FET in this work. unipolar p- and n-type $MoTe_2$ FETs with 10^5 and 10^6 on-off ratios are achieved through rapid thermal annealing (RTA) and Benzyl Viologen (BV) doping respectively. By varying the vacuum level in RTA chamber before annealing and BV dopant concentration, annealing condition, both hole and electron doping concentration can be modulated in a wide range from slight doping to degenerate like doping. Furthermore, Al_2O_3 is deposited onto the device surfaces for the mobility engineering. Hole and electron mobilities are improved to 62 cm^2/Vs and 82 cm^2/Vs respectively after Al_2O_3 capping; they are among the highest carrier mobilities of $MoTe_2$ transistors ever obtained. A lateral homogeneous $MoTe_2$ p-n diode is fabricated combining the electron and hole doping techniques, the device displays excellent diode properties with a high rectification ratio of 10^4 at 0 gate bias and an ideality factor of 1.2.

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