High performance p-type MoS_2 transistor enabled by chemical doping

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Abstract

The accessibility of p-type MoS_2 FET (PFET) has been a stumbling block for complementary device applications involving MoS_2.[1] The strong pinning effect at metal-MoS_2 interface has been considered to be the leading cause of unipolar n-type MoS_2 FET (NFET).[2] In this study, both non-degenerate MoS_2 PFET with high on/off ratio (10^9 at 133K) and gate independent degenerate MoS_2 PFET with high hole current density were enabled by controllable chemical doping.[3] Hole mobility of the doped non-degenerate MoS_2 PFET was measured to be 72 cm^2/Vs at room temperature, and this value is further increased to 132 cm^2/Vs at 133K. Channel resistance R_s was proved to limit I_{on} of PFET after careful analysis of carrier transport mechanism in those doped MoS_2 PFETs. Therefore, p-type doping of channel was also necessary for achieving high performance MoS_2 PFET in addition to contact engineering. Based on the high performance PFET, we successfully demonstrated a MoS_2 CMOS inverter by integrating NFET and PFET.

References

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