
N-type doping of tungsten diselenide by oxygen plasma treatment

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Transition metal dichalcogenides (TMDs), such as molybdenum disulfide (MoS_2), molybdenum diselenide (MoSe_2), tungsten diselenide (WSe_2), rhenium disulfide (ReS_2), are promising materials for flexible, transparent electronics because of their electrical, optical, mechanical properties. Transition from indirect to direct bandgap occurs when TMDs scale goes bulk to monolayer, so TMDs like MoS_2 and WSe_2 indicates excellent performance as optoelectronic device. Because ion-implantation can't apply for TMDs materials, many doping method research, including in-situ, charge transfer and dipole moment doping, are currently studied. One of doping methods is using plasma treatment. There is p-doping through O_2 , CF_4 , CHF_3 plasma treatment on MoS_2 . However, in case of WSe_2 , no electrical analysis of plasma-induced doping is studied yet.

In this paper, we demonstrate the effect of O_2 plasma treatment on WSe_2 with I-V measurement. First, we use reactive ion etching (RIE) for O_2 plasma treatment on WSe_2 flake. This work is carried out in 10 seconds. The plasma power is set to 20W. Next, we make WSe_2 TFT device for measurement. Pristine WSe_2 TFT indicates p-type or ambipolar transistor. However, electrical analysis indicates plasma treated WSe_2 TFT as n-type transistor. This experiment shows on-currents ($10^{-7} \sim 10^{-6}$ A), off-currents ($10^{-10} \sim 10^{-9}$ A), threshold voltage (-20 ~ -10V)