Supplementary Information

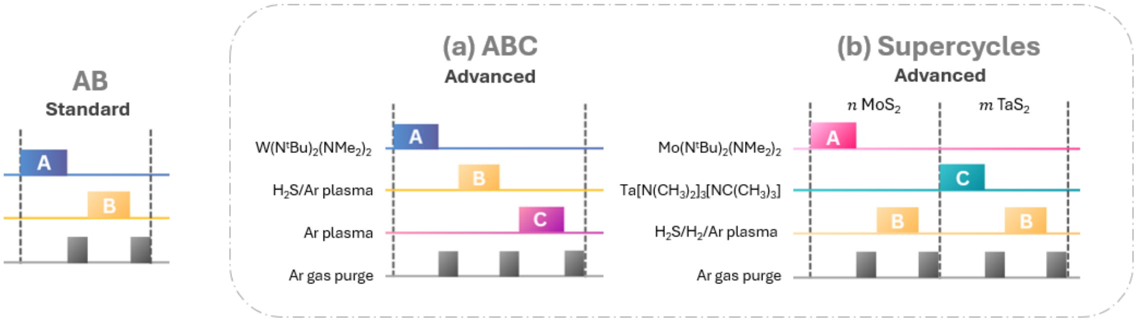
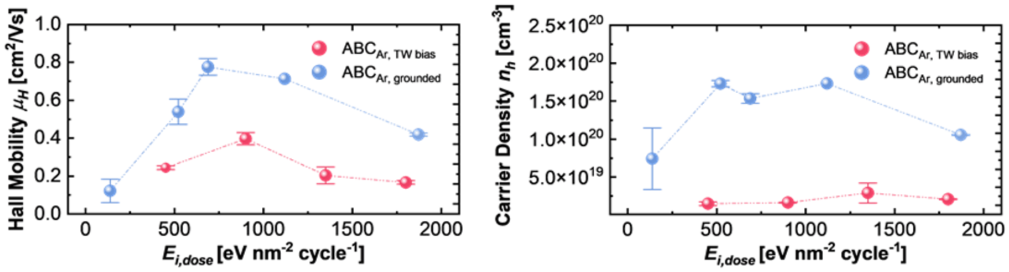


Figure 1: Process diagrams for doping TMDCs using an (a) ABC-type PEALD for WS_2 introducing an argon (Ar) plasma and (b) PEALD supercycle process for Ta-doped MoS_2 films controlling the composition by the cycle ratio $n:m$.

(a) **Hall effect: WS_{2-x}**



(b) **Hall effect: $Ta_yMo_{1-y}S_2$**

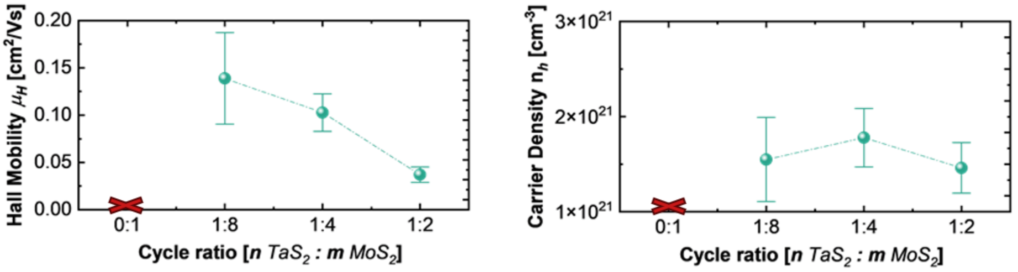


Figure 2: Hall effect measurements for (a) ABC WS_2 using a grounded and biased argon (Ar) plasma and (b) $Ta_yMo_{1-y}S_2$ showcasing the changes in the Hall mobility μ_H and carrier density p as function of the ion energy dose $E_{i,dose}$ (WS_{2-x}) and the cycle ratio ($Ta_yMo_{1-y}S_2$).