Supporting Information

Understanding the Impact of Annealing on Interface and Border Traps in the $Cr/HfO_2/Al_2O_3/MoS_2$ System

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Optical photos of a representative device

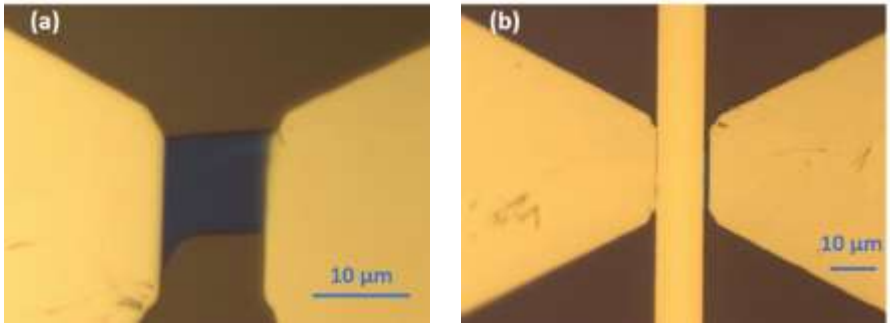

Fig. S1. Optical photos of a representative device (a) After S/D metal deposition; (b) After gate metal deposition.

Table S-I. Parameters used/extracted in simulation

	MoS_2	Al_2O_3	HfO_2
Electron affinity (eV)	4.3	1.45	2.2
Band gap (eV)	1.25	8.8	6.0
Tunneling effective mass (m_o)	0.53	0.2	0.5
Doping or oxide charge (cm^{-3})	6×10^{17}-9×10^{18}	7.45×10^{19}-1.35×10^{20}	1×10^{20}

Interface traps
Relaxation energy 0.72 eV
Capture cross section 8×10^{-20}-1.6×10^{-18} cm^2

Border traps
Relaxation energy 0.72 eV
Capture cross section 5×10^{-18} cm^2

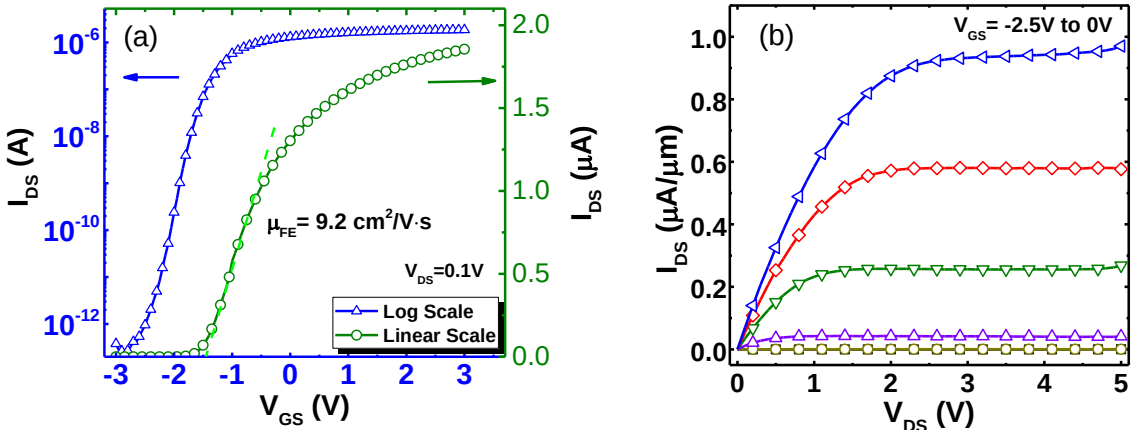

Fig. S2. Typical (a) I_{DS}-V_{GS} (b) I_{DS}-V_{DS} characteristics for the as-fabricated MoS_2 transistors in this work with peak field effect mobility μ_{FE} values around 9.2 $cm^2/V{\cdot}s$ and I_{ON}/I_{OFF} ratios larger than 10^6. Since there is inherent variability in MoS_2 flakes, similar variability was observed in the current characteristics, such as subthreshold slope variation associated with the frequency dispersion dependence of the C-V data. (Data above is for Device 3.)

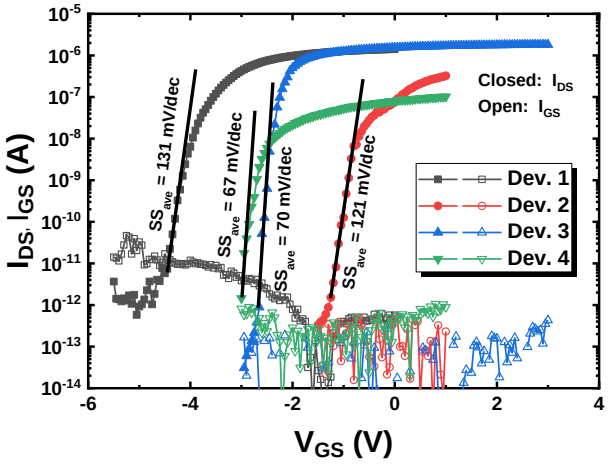

Fig. S3. Typical (a) I_{DS}-V_{GS} (closed symbols) and I_{GS}-V_{GS} (open symbols) characteristics for the as-fabricated MoS_2 transistors used in this work. The plots illustrate the extracted average subthreshold slope (SS) which correlate with the extracted D_{it} of Table I. Furthermore, extremely low gate leakage currents were obtained for these devices.

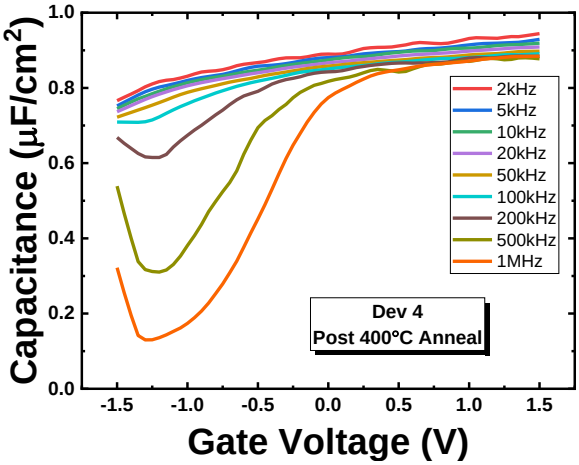

Fig. S4. Multi-frequency C-V result for device #4 after a 400°C FGA. The 400˚C FGA largely degrades the interfaces and performance of devices with $HfO_2/Al_2O_3/MoS_2$ stacks where confirmation of this is observed in device #4, which originally showed no appreciable D_{it} (Fig. 4). The C-V data should have simply reproduced the pre-annealed results for device #4, if 400°C did not degrade the device.