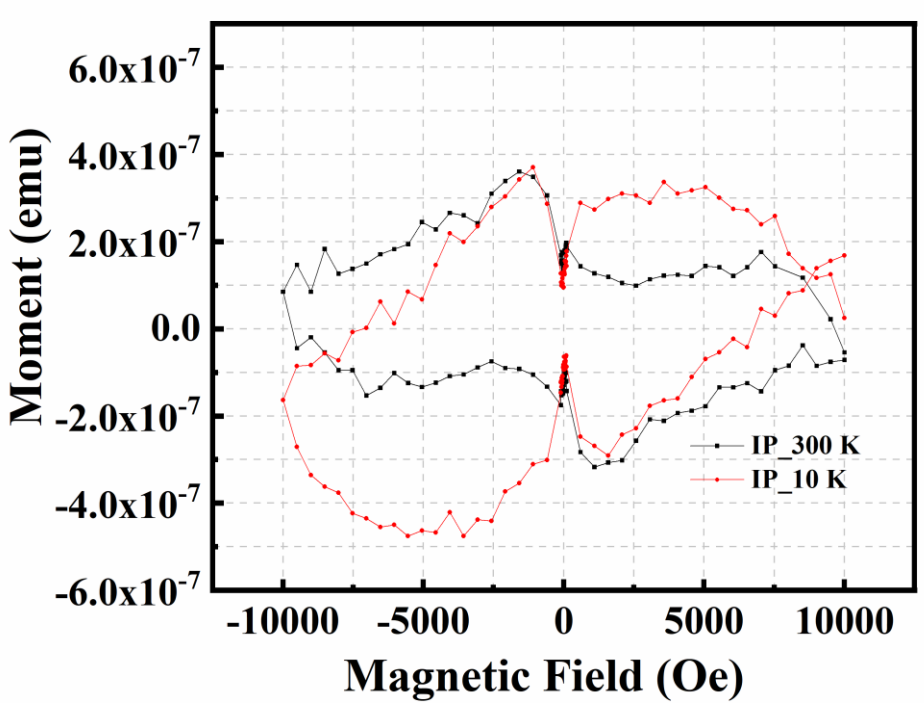
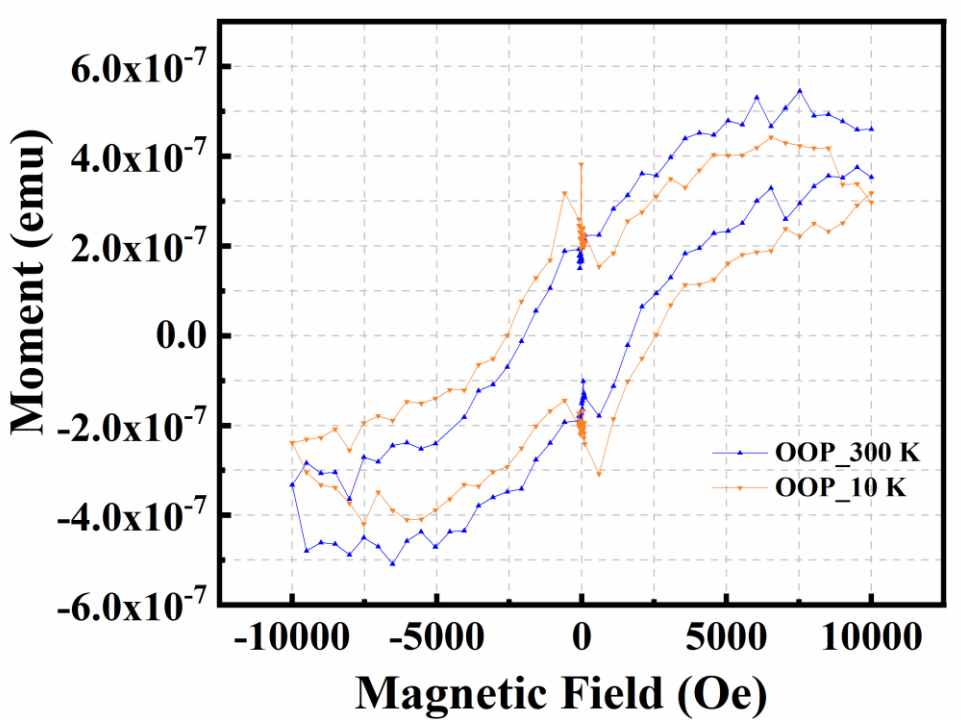
Intrinsic thin film M-H Results and MPMS Sample Handling: example from transition metal dichalcogenide films (TMD)

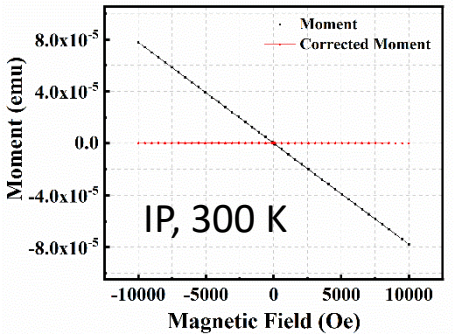
Xiangkai Liu

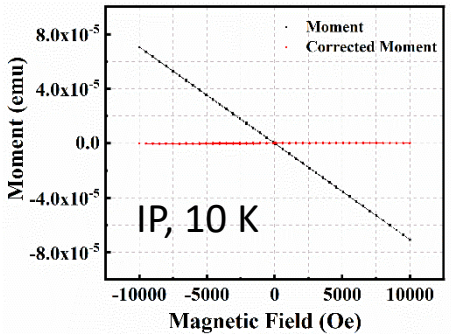
2021.02.18

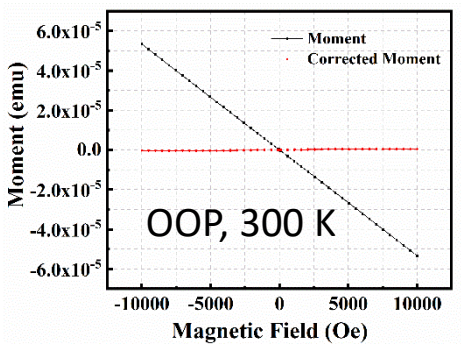
Recap : Bare Si/SiO_2 Substrate after Dummy Wet Transfer

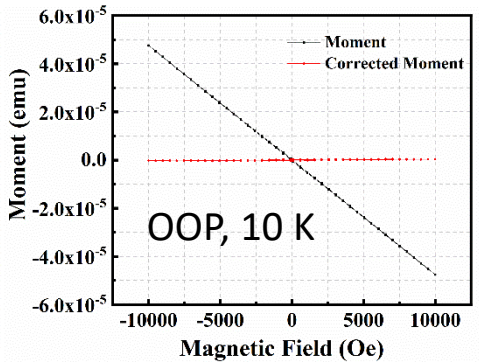








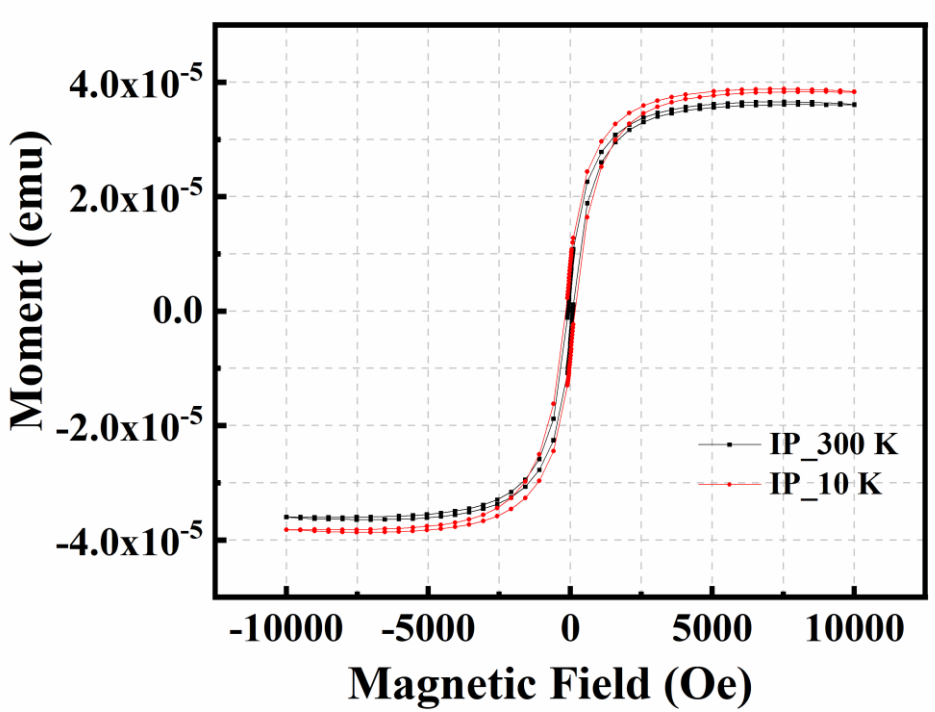


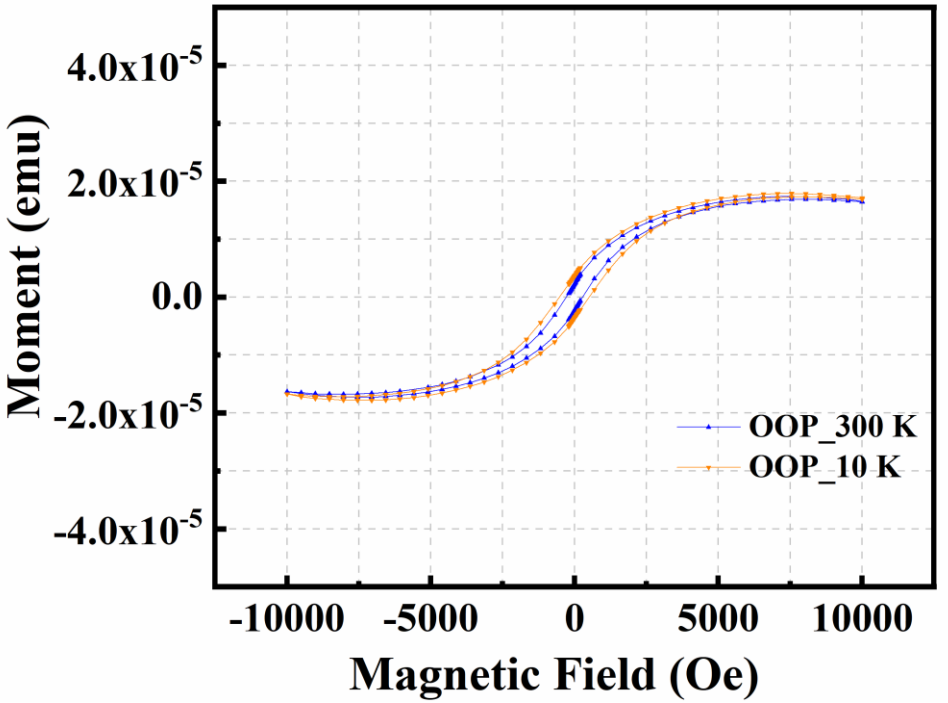


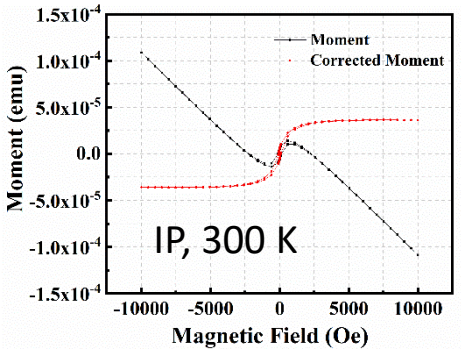
20 nm Si/SiO_2 substrate, **Si substrate cutting---dummy wet transfer---sonication thorough cleaning**

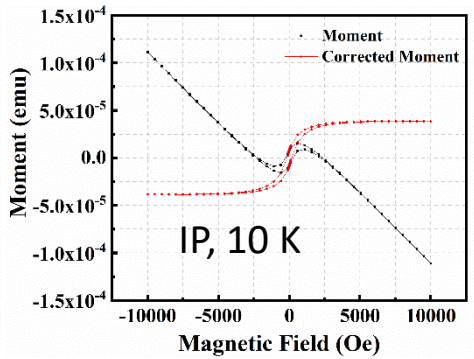
- By proper cleaning and using non-magnetic straw for the measurement, the ferromagnetic response coming from the organic residue in the wet transfer is very small.

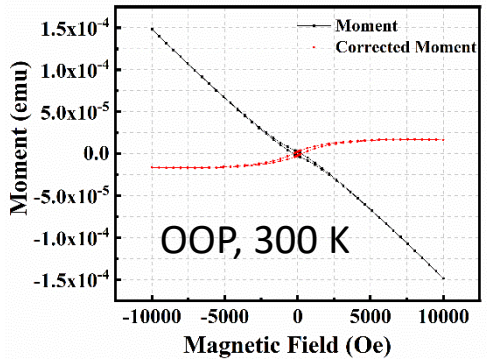
Recap : Original TMD film on sapphire

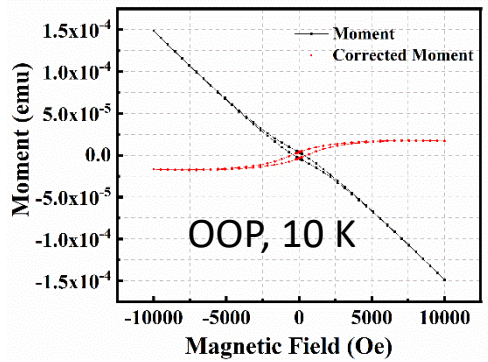








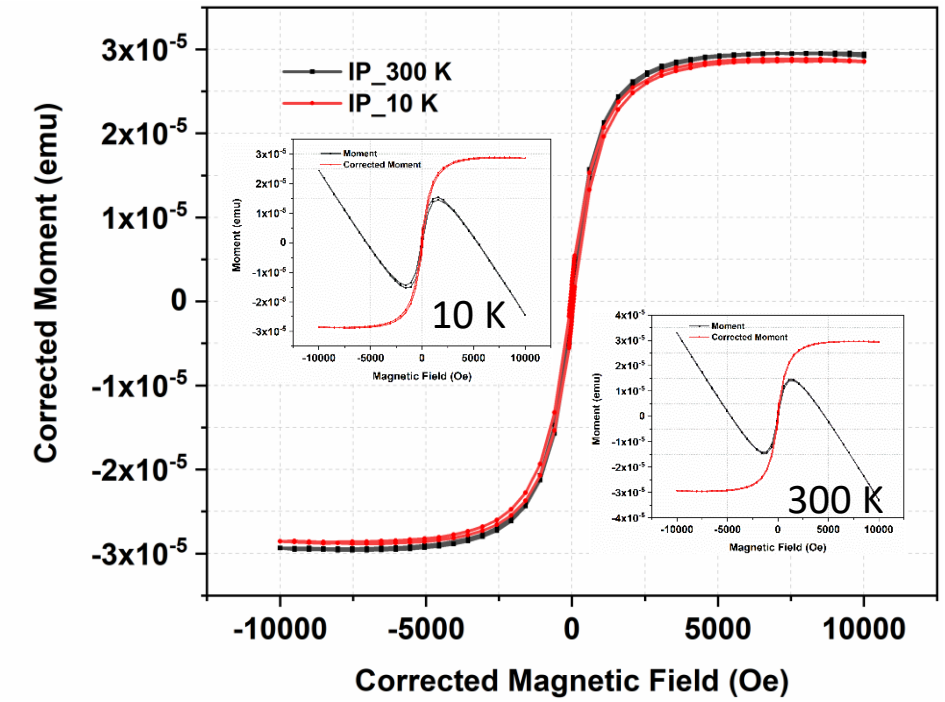




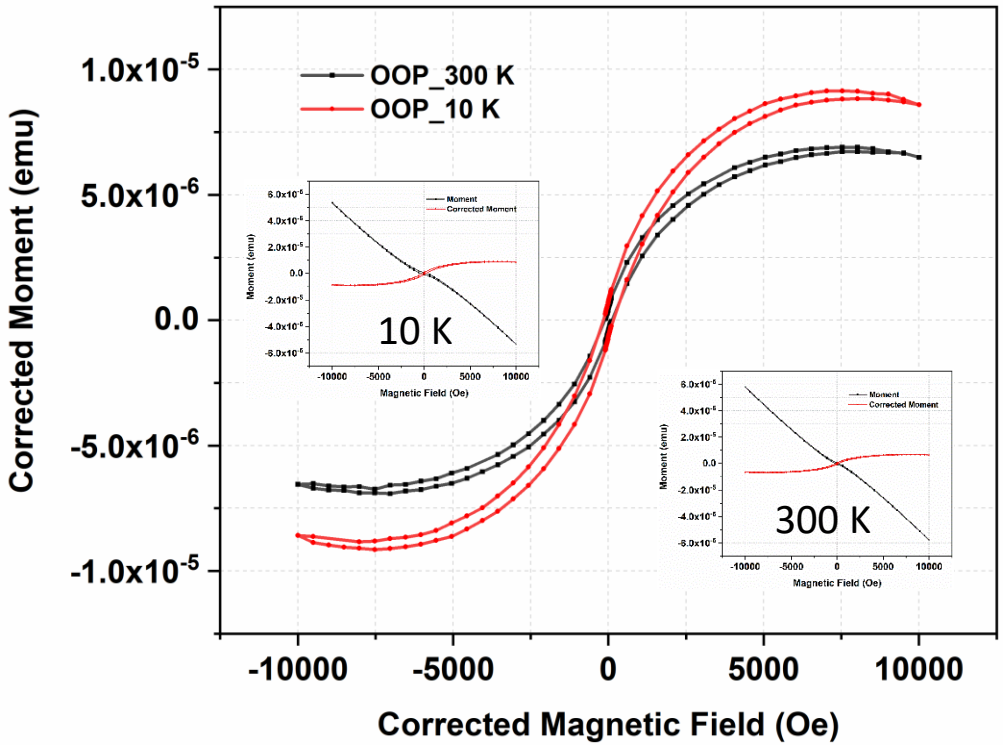
TMD film on sapphire, **sample cutting---solvent rinse cleaning**

- Dubious ferromagnetic response probably come from the impurity introduced in the cutting process, where Si cutting board in the cleanroom is used for the cutting.

Recap : TMD film transferred on Si substrate



IP

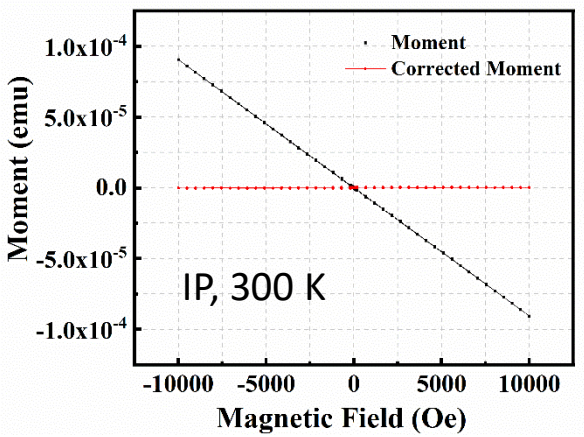


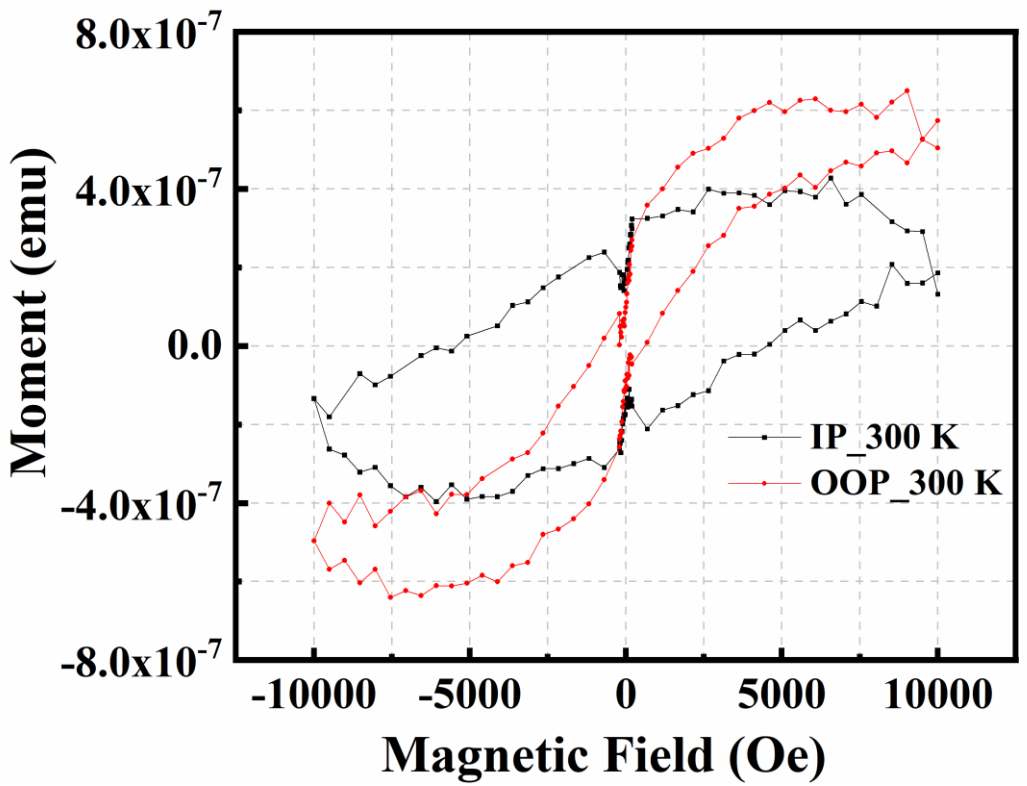
OOP

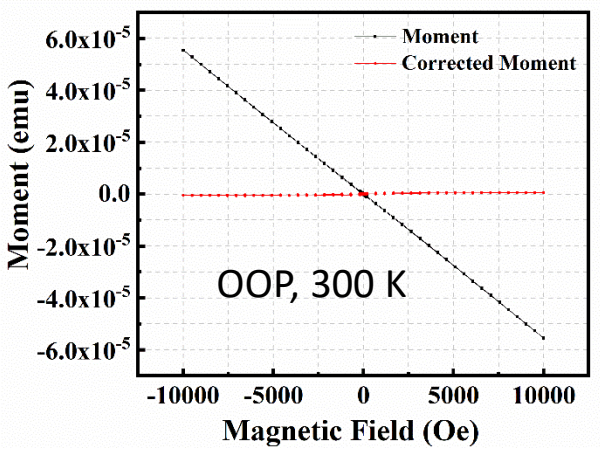
TMD film transferred on 20 nm Si/SiO_2 substrate, **wet transfer---sample cutting---solvent rinse cleaning**

- Dubious ferromagnetic response probably come from the impurity introduced in the cutting process, where Si cutting board in the cleanroom is used for the cutting.

Bare Si/SiO_2 Substrate after Careful Cleaning



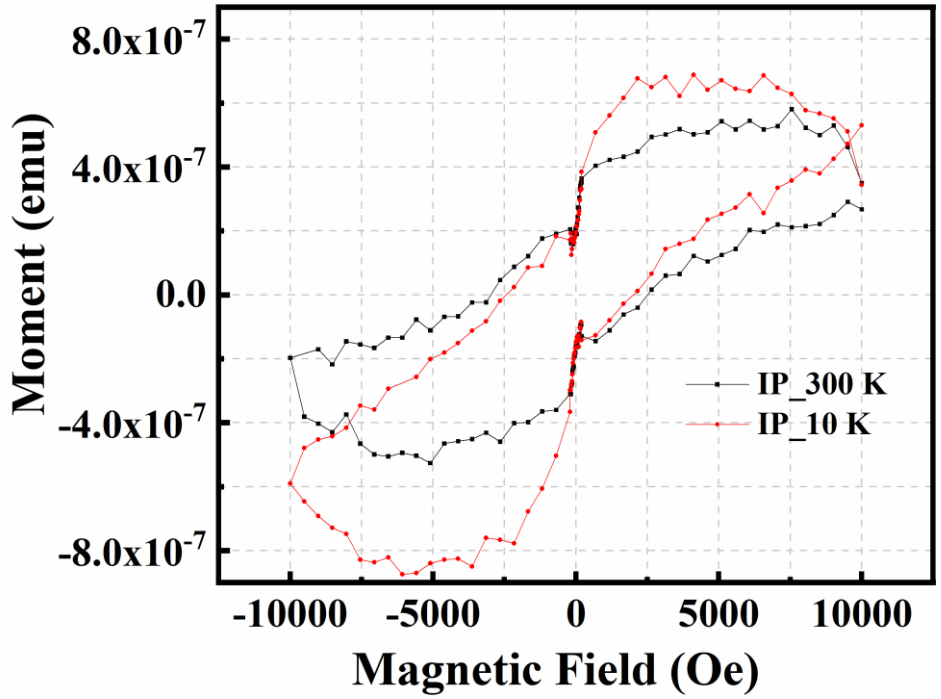


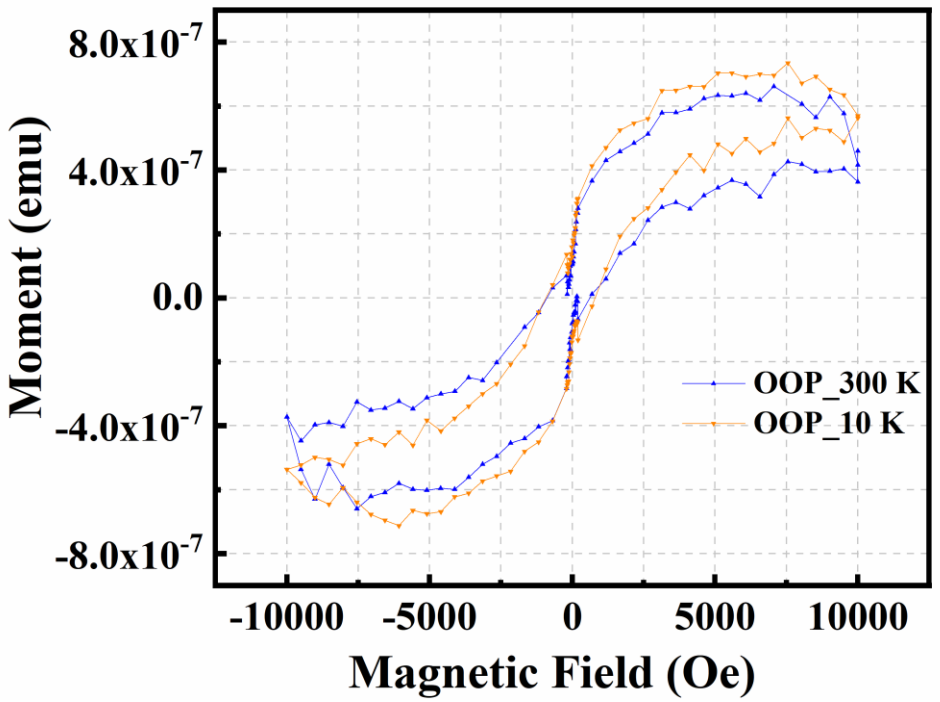


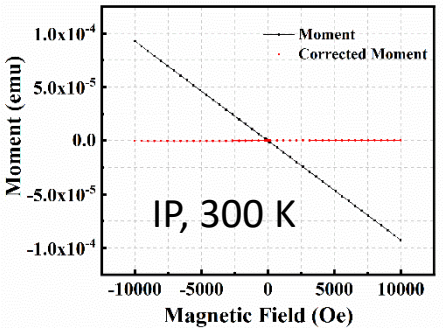
20 nm Si/SiO_2 substrate, **Si substrate substrate cutting---sonication thorough cleaning**

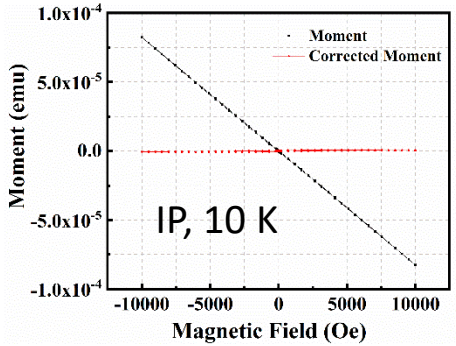
- Si substrate is observed to be diamagnetic after thorough sonication cleaning and careful handling. The ferromagnetic response coming from other magnetic impurity is very small.

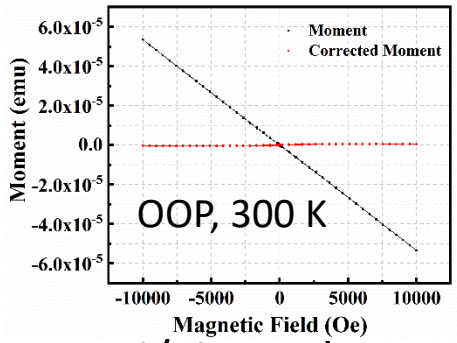
TMD film Transferred on Si Substrate

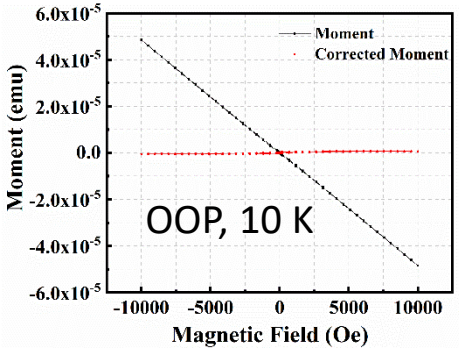












TMD film transferred on the same 20 nm Si/SiO_2 substrate

Bare Si substrate cutting---sonication thorough cleaning---TMD transfer---solvent rinse cleaning

- The magnitude of ferromagnetic response from the transferred TMD sample is almost the same as the bare Si substrate after high-field correction, which suggests that this TMD is not intrinsically ferromagnetic.

Conclusions

- **If the sample/substrate has been cut by the Si cutting board in the cleanroom, then it is better to do sonication solvent cleaning (TAI, 5 mins each) to get rid of ferromagnetic impurity introduced in this process. Simple solvent rinse cleaning may not be strong enough to achieve the same purpose.**

- **If the sample is easy to handle, then it is prioritized to use diamond cutter and blade in the spin lab for the cutting.**

- **If no cutting is involved in handling the sample, simple solvent rinse cleaning should be enough to remove magnetic impurity.**

- **Use non-metallic tweezer to handle the sample during cleaning or cutting.**