

Supplemental materials

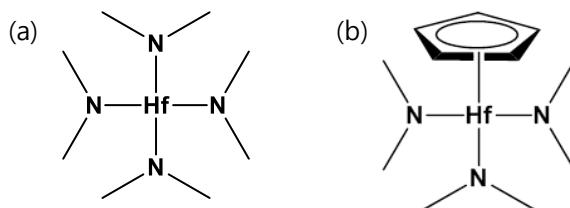


Figure 1 : The structure of precursors (a) $\text{Hf}(\text{N}(\text{CH}_3)_2)_4$, (b) $\text{CpHf}(\text{N}(\text{CH}_3)_2)_3$.

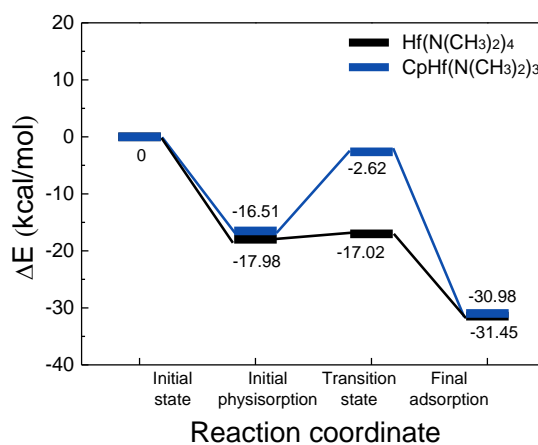


Figure 2 : Reaction path and predicted energetics on Si during 1st half-reaction. The result of calculated E-barrier as $\text{Hf}(\text{N}(\text{CH}_3)_2)_4$: 0.96 kcal/mol, $\text{CpHf}(\text{N}(\text{CH}_3)_2)_3$: 13.9 kcal/mol.

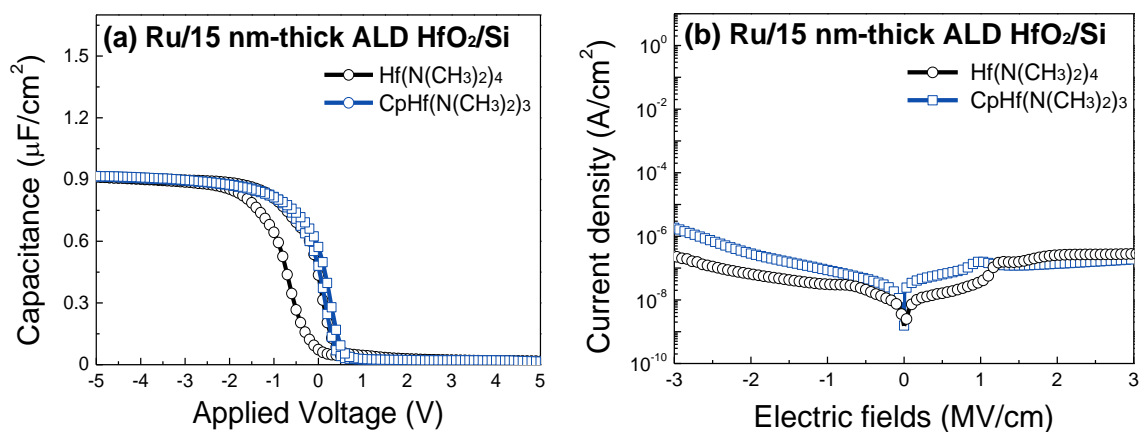


Figure 3 : The electrical properties of MOS capacitors using 15-nm thick ALD HfO_2 (a) C-V curves and (b) I-V curves.