Abstract Title: Optical Bandgap and Thermal Stability Driven High-κ Engineering of HfAlO Dielectrics on a 200 mm ALD Platform

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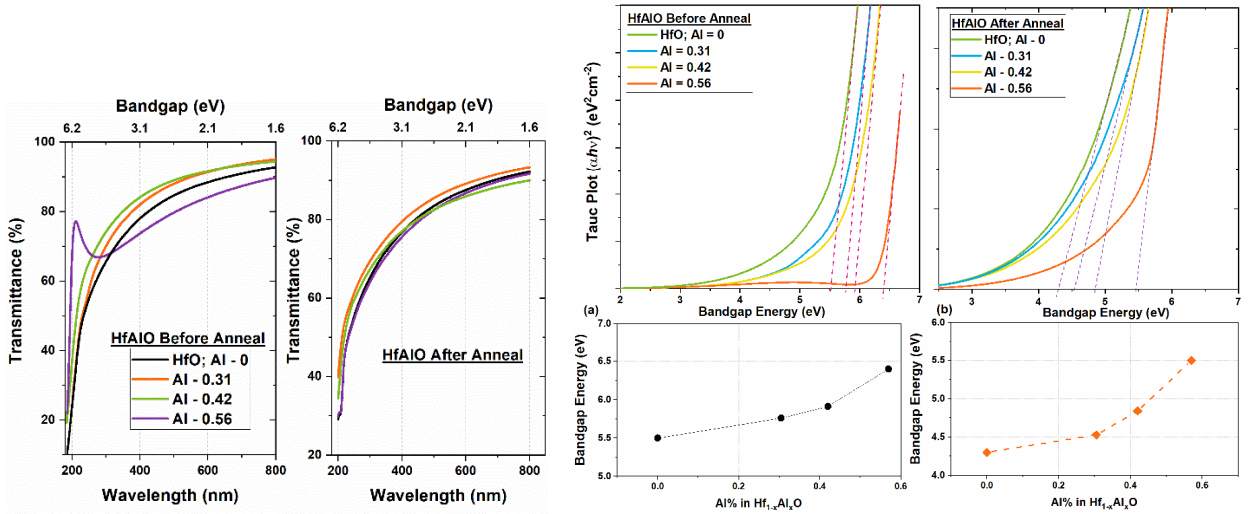

Fig S1: (Left) Transmittance data of HfAlO with various Al% before and after annealing at 650°C. On the right side is the Tauc plot, which represents the optical bandgap data (bottom) of the alloy before and after annealing conditions.

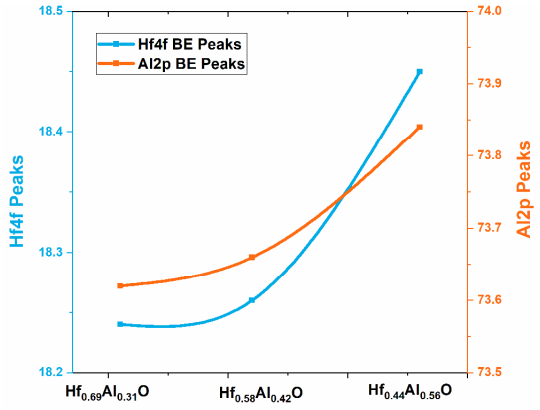

Fig S2: Hf4f and Al2p peak variations were plotted with various Al incorporations. With more Al content in the alloy, both peaks shift to higher binding energy.

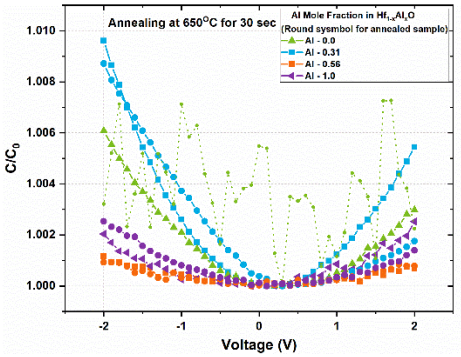

Fig S3: Relative capacitance of various Al mole fractions in $Hf_{1-x}Al_xO$ before and after annealing over the applied voltage range.

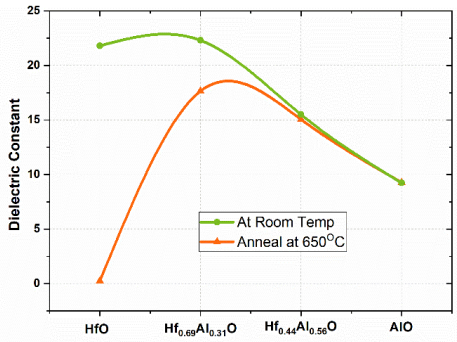

Fig S4: Dielectric constant with respect to Al content in hafnium aluminate. After annealing at higher temperatures, HfO_2 becomes leaky, while a low Al content alloy holds the highest k-value. Here, the high Al content alloy shows a 68% higher k-value than Al_2O_3, even under thermal stress

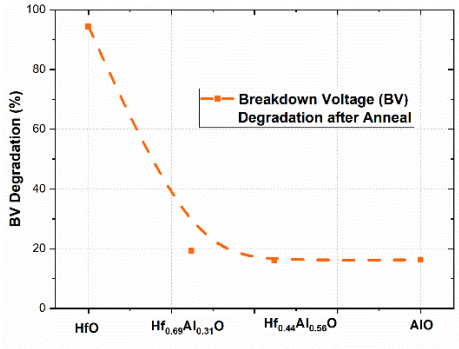

Fig S5: Breakdown voltage degradation due to annealing at 650°C of Hf-Al-O alloyed film with Al mole fraction zero to 100%