

Supplementary Information

Advanced Atomic Layer Deposition: Metal Oxide Thin Film Growth Using the Discrete Feeding Method

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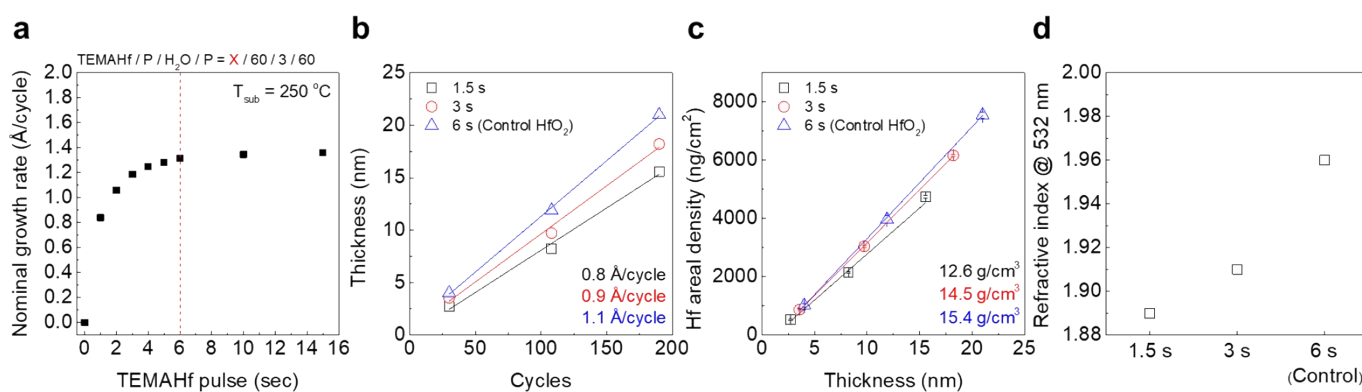
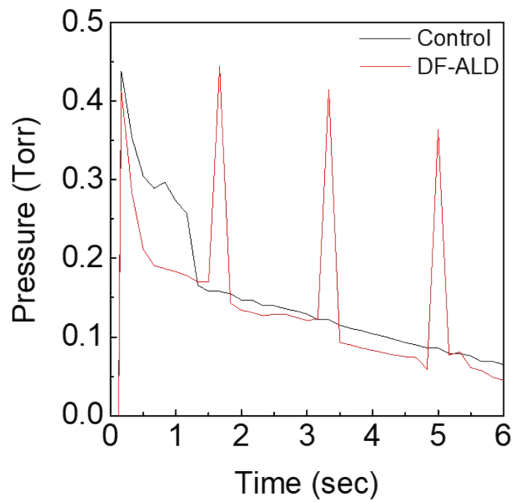


Fig. S1 (a) Nominal growth rate of the HfO₂ film as a function of the Hf precursor pulse time. Comparison of the (b) growth rate, (b) nominal density, and (c) refractive index of HfO₂ films with various feeding time of precursor.



```

integ1
Input
  iy = [Book2]Sheet1!(A"Time",B"Pressure")
Output
  oy = [Book2]Sheet1!(E"Integrated X1",F"Integrated Y1")
(Control) area = 9.20125

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integ1
Input
  iy = [Book2]Sheet1!(C"Time",D"Pressure")
Output
  oy = [Book2]Sheet1!(G"Integrated X2",H"Integrated Y2")
(DF-ALD) area = 9.19692

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Fig. S2 Time-dependent pressure variation during the feeding of precursor in the control and DF-ALD processes. The integrated area value shows the exposure amount of the precursor in each process.

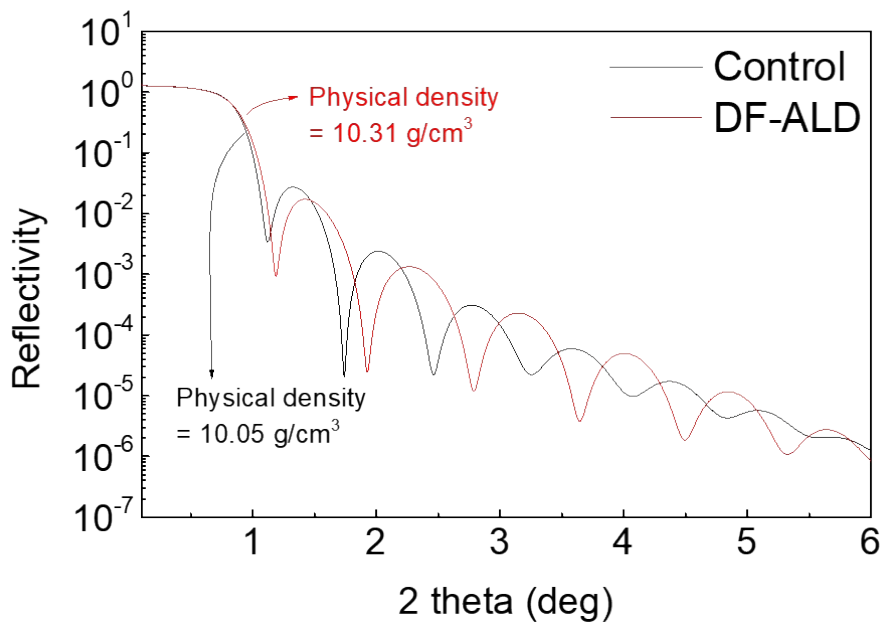


Fig. S3 XRR results for control and DF-ALD HfO_2 films with the thickness of ~ 10 nm.

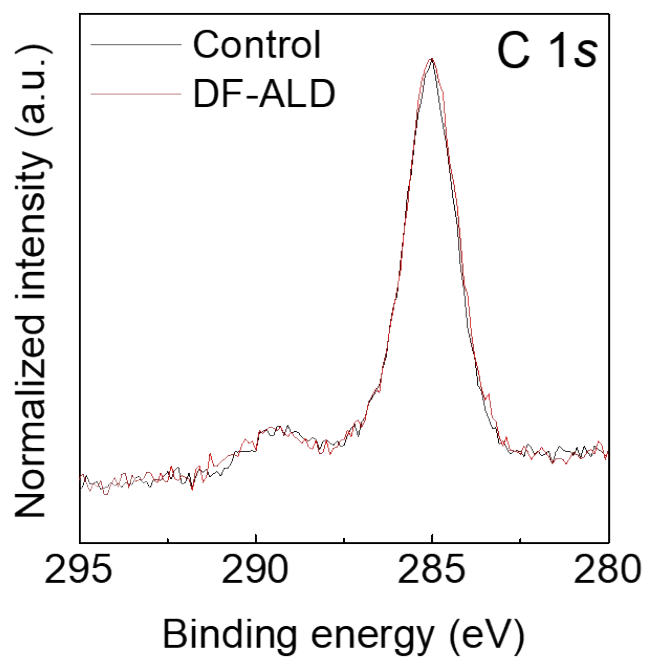


Fig. S4 C 1s core level XPS spectra of HfO₂ films grown via control and DF-ALD processes.