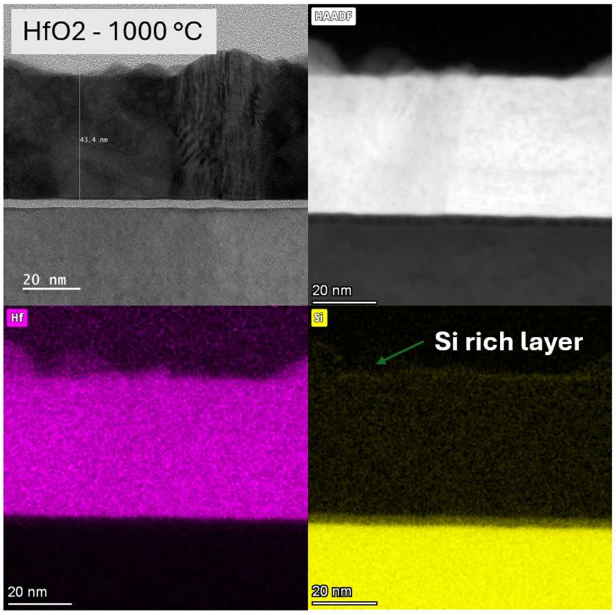


Figure 1. TEM imaging of HfO2 annealed at 1000 C. Raw imaging of HfO2 (top left), High-Angle Annular Dark-Field (HAADF) for contrast (to[p right), HfO2 signal (bottom left), and Silicon signal (bottom right). HfO2 appears more crystalline while maintaining a minimized Si layer.

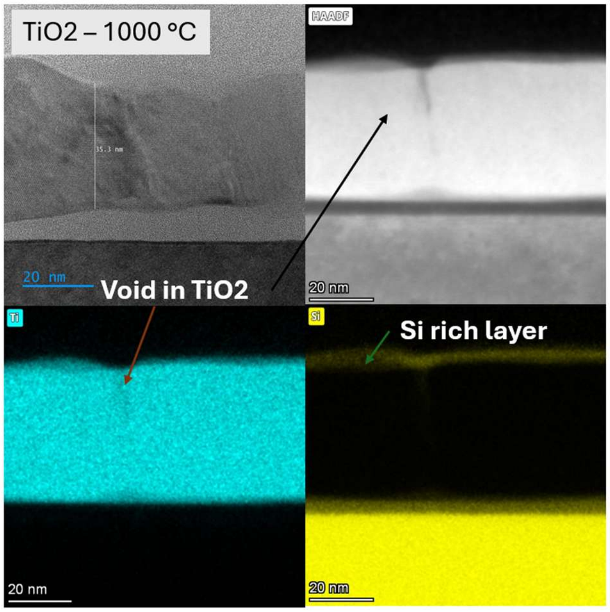
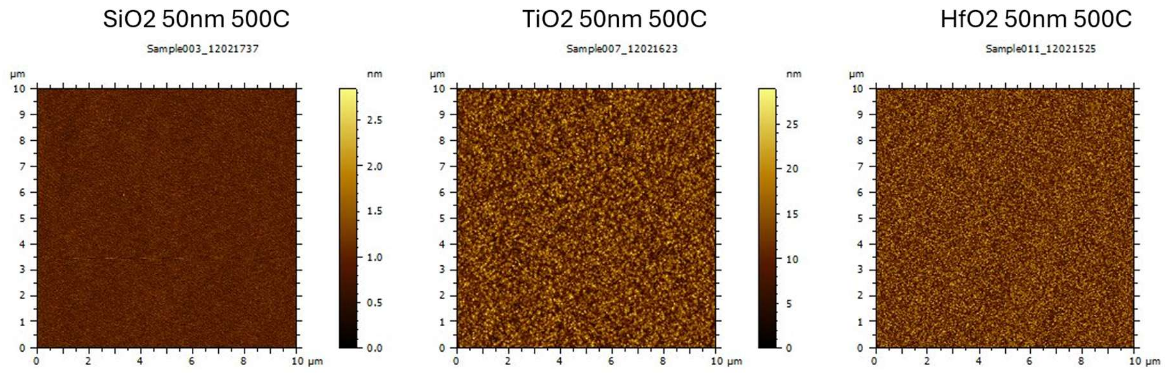


Figure 2 TEM imaging of TiO2 annealed at 1000 C. Raw imaging of TiO2 (top left), High-Angle Annular Dark-Field (HAADF) for contrast (to[p right), TiO2 signal (bottom left), and Silicon signal (bottom right). TiO2 shows signs of void formation with a thicker silicon layer on the surface.

Table 1 AFM surface roughness measurements for SiO2, TiO2, and HfO2 films annealed at 500C and 1000C.

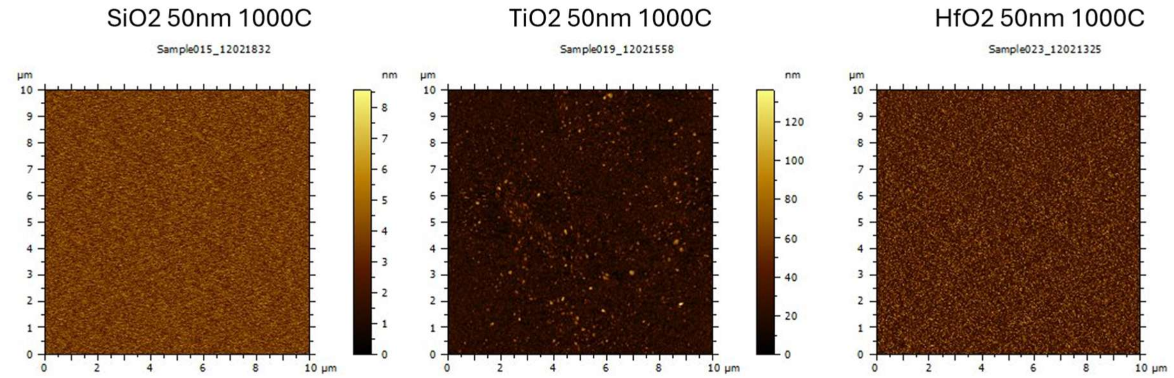
FN Film	Anneal Temp	Sa (nm)	Sq (nm)	Sp (nm)	Sv (nm)
SiO2	**500**	0.14	0.18	1.77	0.85
TiO2	**500**	3.07	3.81	16.44	11.83
HfO2	**500**	2.10	2.59	10.96	7.81
SiO2	**1000**	0.65	0.81	4.30	3.27
TiO2	**1000**	6.15	9.22	113.59	21.09
HfO2	**1000**	1.75	2.19	11.91	5.62


SiO2 50nm 500C

TiO2 50nm 500C

HfO2 50nm 500C

Figure 3 AFM imaging of SiO2, TiO2, and HfO2 annealed at 500C. TiO2 shows a higher roughness (Sq) and broader range between max height and minimum height (Sp and Sv).


SiO2 50nm 1000C

TiO2 50nm 1000C

HfO2 50nm 1000C

Figure 4 AFM imaging of SiO2, TiO2, and HfO2 annealed at 1000C. TiO2 has the greatest peak to valley range and highest roughness.