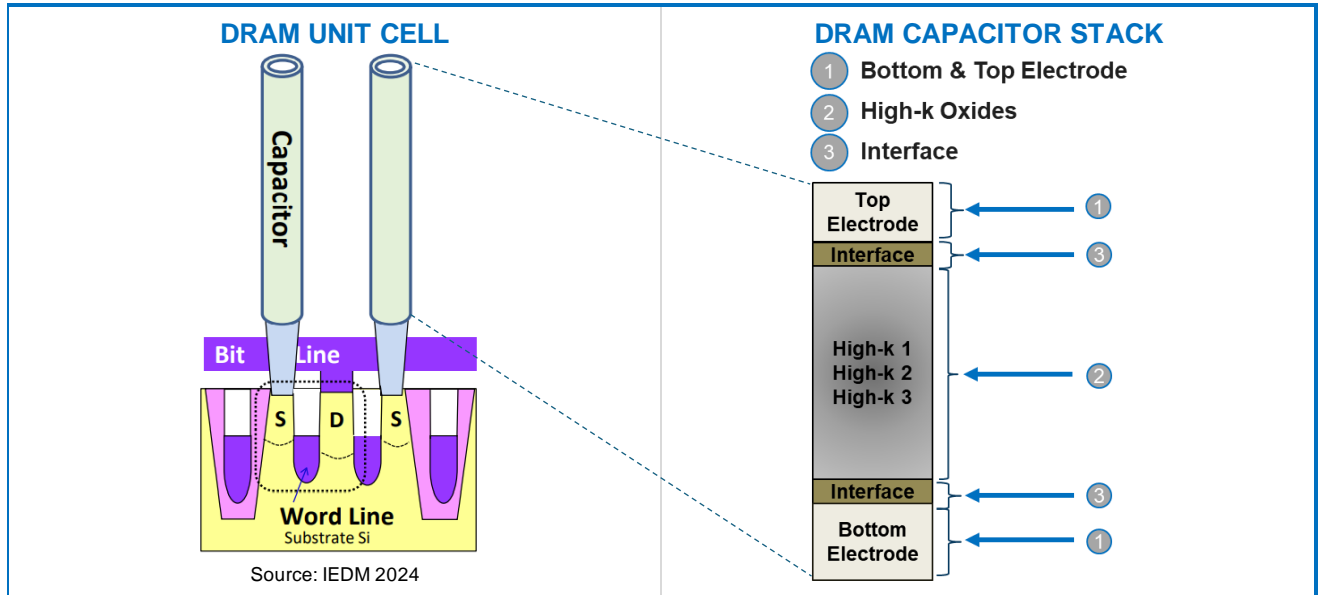


DRAM Scaling Challenges

DRAM CELL & CAPACITOR



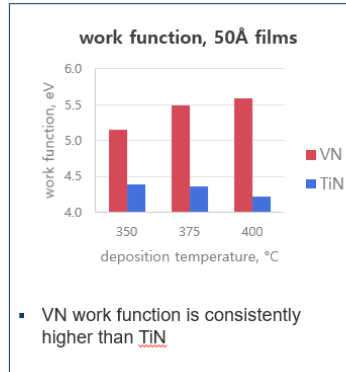
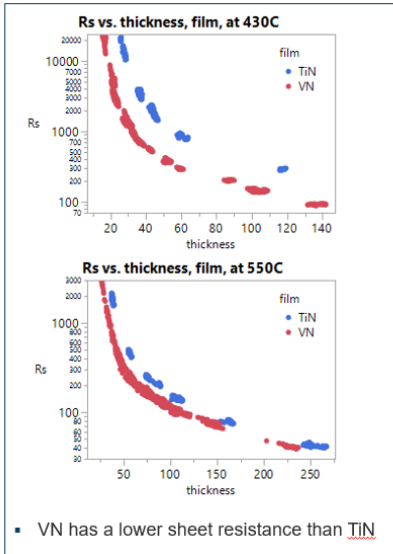
EUGENUS ALD FILMS FOR CAPACITOR MODULE

Sierra	Lassen	Lassen	Sierra
Capacitor Electrode	Capacitor High-k	Capacitor Interface	Atomic Layer Etch
TiN/TSN, VN	ZrO, HfO, AlO, Anti-ferro HfZrOx, TiO	NbO, NbN, MoO, MoN, MoON	NbO, TiN, High-k

DRAM Capacitor Electrode (Eugenus ALD VN vs TiN)

- VN has lower resistivity and higher work function than TiN
- VN provides lower leakage at matched capacitance

Film properties of VN vs. TiN



VN has superior electrical properties than TiN

XPS film composition

XPS Atom.%	VN		TiN	
	avg. value calc. from 4-10 nm sputter depth			
V	46.6	0	0	0
Ti	0	42.0	42.0	0
N	48.3	45.5	45.5	48.3
O	4.2	11.2	11.2	4.2
Cl	0.5	0.8	0.8	0.5
C	0.4	0	0	0.4
Si	0	0.5	0.5	0
M:N bulk	96.4%	92.3%	92.3%	96.4%

XPS Atom.%	VN		TiN	
	avg. value calc. from 4-10 nm sputter depth			
V	49.2	0	0	0
Ti	0	44.9	44.9	0
N	50.3	50.7	50.7	50.3
O	0	3.8	3.8	0
Cl	0	0	0	0
C	0.1	0.1	0.1	0.1
Si	0.4	0.5	0.5	0.4
M:N bulk	97.8%	88.5%	88.5%	97.8%

- VN and TiN both have acceptable impurity level (Cl, C low)

High-Step Coverage Results (TiN vs VN, Both films >95% Step Coverage)

