Table 1. Comparison of single film as capacitor dielectric with MIM capacitor deposited at 300C

Single film	Capacitance density	Breakdown field
600Å ALD HfO_2	2555 pF/mm2	6.9 MV/cm
600Å ALD Al_2O_3	1444 pF/mm2	7.8 MV/cm
900Å PECVD Si_3N_4	645 pF/mm2	8.7 MV/cm

Table 2. Four different laminate structures as capacitor dielectrics with HfO_2 + SiO_2 that keep the same total thickness of HfO_2 and SiO_2

Laminate	Thickness (Å)	Total HfO_2 thickness	Total SiO_2 thickness
L3: HfO_2+SiO_2+HfO_2	315Å+144Å+315Å	630Å	144Å
L5: HfO_2+(SiO_2+HfO_2) x 2	210Å+(72Å+210Å) x 2		
L9: HfO_2+(SiO_2+HfO_2) x 4	126Å+(36Å+126Å) x 4		
L17: HfO_2+(SiO_2+HfO_2) x 8	70Å+(18Å+70Å) x 8		

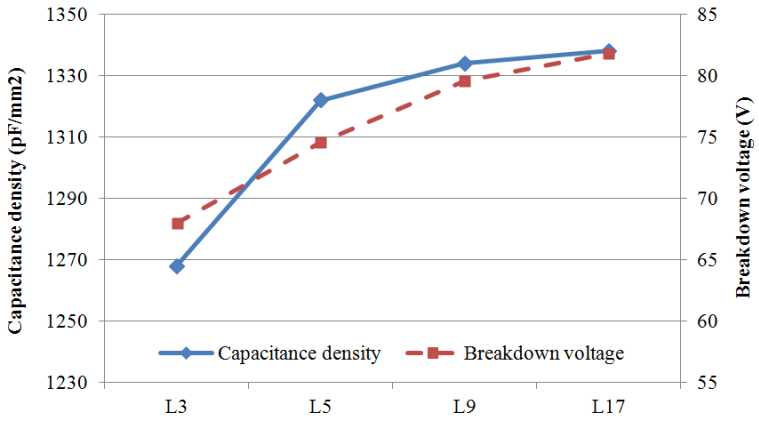

Figure 1. Comparison of capacitance density and breakdown voltage of 4 different laminate structures as MIM capacitor dielectric

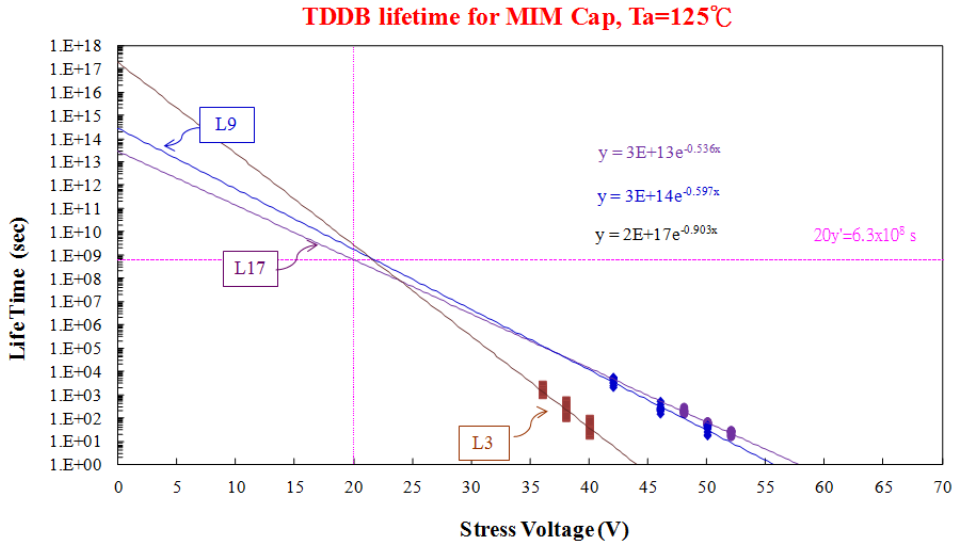

Figure 2. Comparison of TDDB lifetime measured at 125C. Extrapolation was applied to calculate lifetime at 20V after higher voltage stress. The lifetime of L17 capacitor at 20V is the shortest, but the breakdown voltage at room temperature is the highest.