Supporting Information: Results of measurement on 10nm thick Si:HfO_2 films deposited with ALD on Si wafers capped with 10nm TiN. After capping with TiN, the films were spike annealed at 800°C.

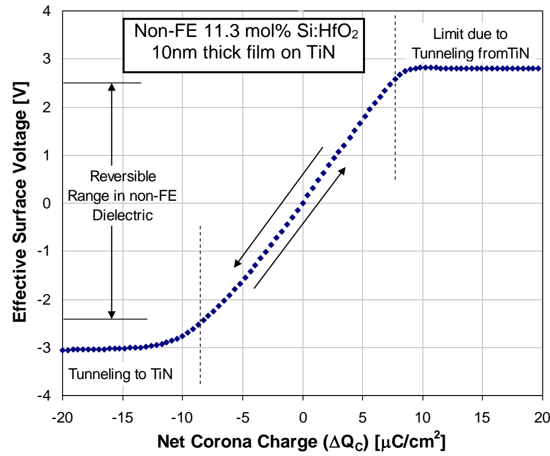

Fig. 1. Illustration of high corona-charge voltage saturation due to corona-charge neutralization in tunneling field range.

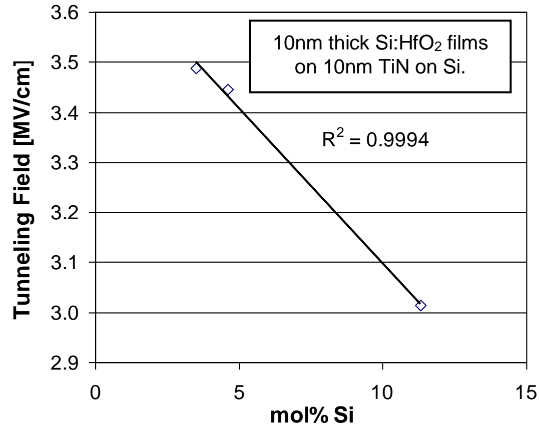

Fig.2. Positive corona-induced tunneling field limit in 10nm thick Si:HfO_2 vs. % Silicon.

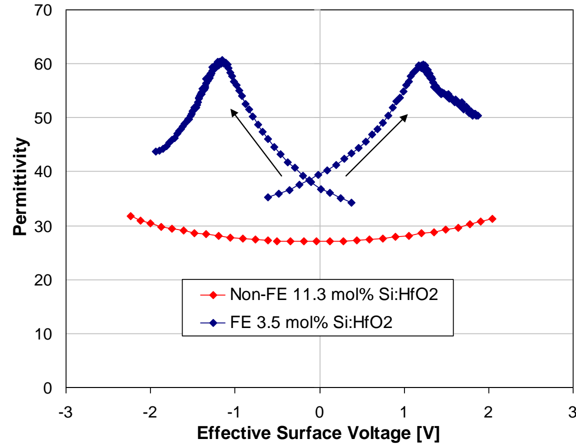

Fig.3. Reversible polarization demonstrated for the 3.5 mol% Si:HfO_2 by corona-hysteresis of permittivity after positive poling. These non-contact corona-Kelvin results are very similar to standard C-V hysteresis measurements.

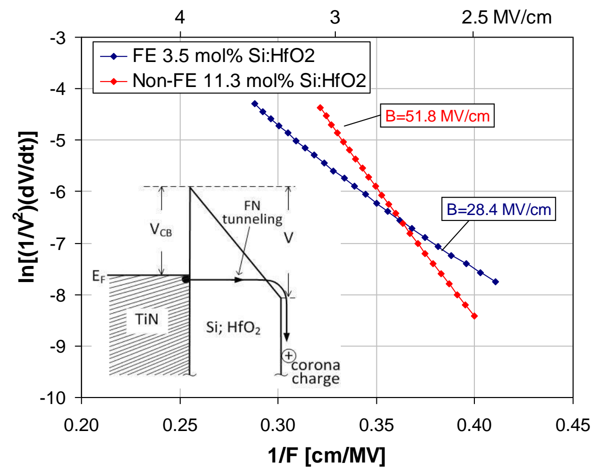

Fig.4. Fowler-Nordheim plot based on corona-Kelvin voltage decay after positive charging (electron tunneling from TiN to Si:HFO_2 conduction band). V_{CB} varies with %Si.

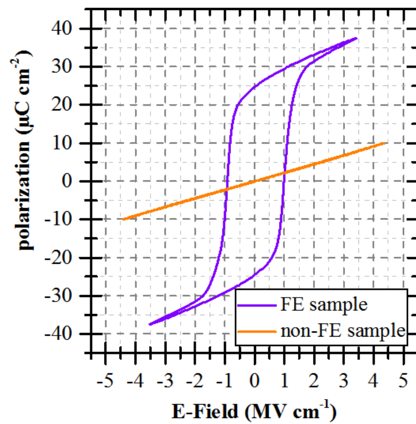

Fig.5. Standard P-E hysteresis loop measurements for 10nm thick FE and non-FE Si:HfO_2 with 3.5 mol% and 11.3 mol% Si.

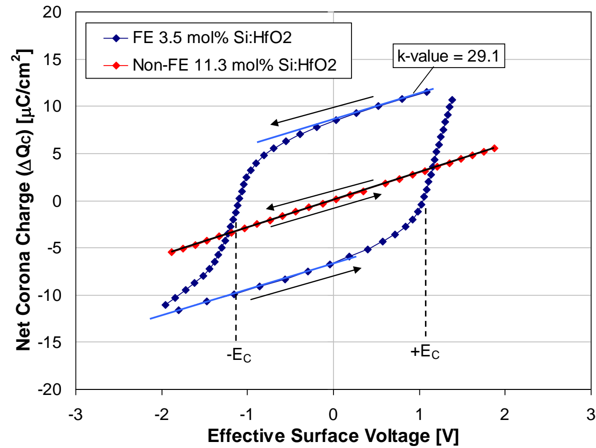

Fig.6. Corona-Hysteresis loop revealed in 3.5 mol% Si:HfO_2 by Kelvin Q-V after positive poling and non-hysteresis Q-V in 11.3 mol% Si: HfO_2. Both films are 10nm thick.