Scaling down of dynamic random access memory (DRAM) towards 2X node will require a reduction of both equivalent oxide thickness (EOT) to ≤ 0.45 nm while maintaining a leakage current density \( J_g \) of \(-7 \times 10^{-7}\) A/cm\(^2\) at \( ± 1\) V of the metal-insulator-metal capacitors (MIMCAP). Moreover, the ITRS roadmap recommends a reduction of the physical thickness of the insulator to 7 nm or less. In this respect, the dielectric employed requires a dielectric constant \( k \) of at least 60. However, an increase of dielectric constant is commonly associated with a low bandgap, which results in an increase of the leakage current through the dielectric. In spite of the high dielectric constants of at least 80, the low bandgap of \(-3.0-3.2\) eV of strontium titanate and rutile TiO\(_2\) makes it difficult to reduce the physical thickness without compromising the leakage current density to fulfill the above mentioned specifications. Another important aspect is the choice of the metal electrode where the work function, thermal stability, absence of interfacial “dead layer” are key factors in improving the performance of the MIMCAPs. Finally, both the dielectric and the metal should be deposited by highly conformal techniques such as Atomic Layer Deposition (ALD). We have previously shown how the dielectric constant, the bandgap, and the EOT-J\(_g\) dependence for the injection from bottom electrode (BE) dielectric(TiO\(_2\) or STO)/TiN(top electrode, TE) at similar physical thickness (\(~9\) nm) as deposited (see figure 1), STO show better properties in respect of both EOT and \( J_g \).

Based on our results, STO ALD is highly promising for the industrial implementation of higher-k dielectrics in DRAM MIMCAP with a design rule of 20 nm.

**Figure 1.** EOT-J\(_g\) dependence for the injection from BE (+1V) and TE (-1V), respectively on 59 dies (300 mm diameter wafers).


