

SUPPORTING INFORMATION ON OXIDE CAPACITANCE MEASUREMENT, NOMINAL STRAIN MEASUREMENT AND TRANSPARENCY MEASUREMENT

MANUSCRIPT TITLE: Can We Build a Truly High Performance Computer Which is Flexible and Transparent?

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Oxide Capacitance Measurement

In order to determine the normalized oxide capacitance (C_{ox}) of the high-k/metal gate stack, we have separately fabricated metal-oxide-semiconductor capacitors (MOSCAPs) with the same material stack and processes. It is to be noted that capacitors were not subject to the release process nor have releasing holes.

Capacitance vs. voltage characteristics (C-V) were measured with a LCR meter (Agilent, E4980A) attached to a probe station, for several devices. Taking the capacitance value at saturation (C_{max}) can give us a very good estimate of the capacitance due to the high-k material (C_{ox}). Figure S1 shows a histogram with the measured normalized capacitance. The measurements give an average capacitance of $1 \mu\text{F cm}^{-2}$, which represents an effective oxide thickness (EOT) of 3.43 nm.

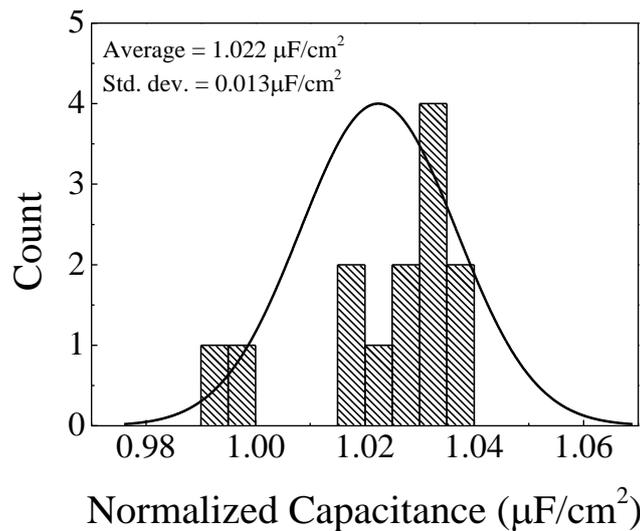


Figure S1. Histogram of normalized oxide capacitance for high-k/metal gate stack.

Nominal Strain on a Silicon Fabric

Strain can be seen as the change or deformation between a stressful state over the normal state. Nominal strain or engineering strain is defined then as $l-L/L$, where L is the original length and l is the final length of the sample. Figure S2 shows the geometry of a strained sample with the definition of the dimensions.

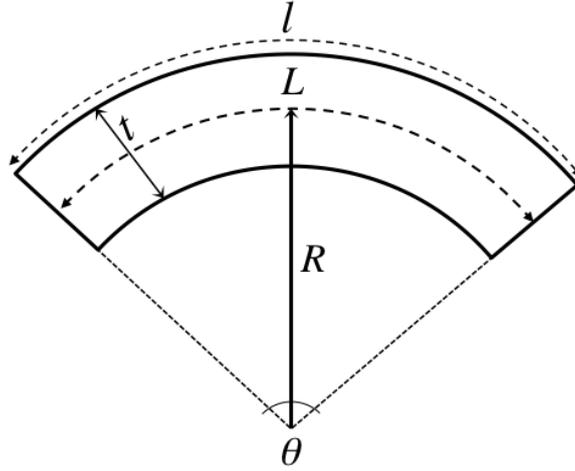


Figure S2. Definition of dimensions for a sample under strain.

Taking this schematic as starting point we can derive the nominal tensile strain at the top surface of the sample where the devices are located.

$$\epsilon_{\text{nom}} = \frac{l-L}{L} = \frac{[(R+t/2)\cdot\theta]-L}{L} = \frac{t\theta}{2L} = \frac{t}{2R} \quad (1)$$

Where t is the thickness of the fabric, R is the bending radius, θ is the angle of curvature and we also know that $R\theta = L$.

Transparency measurements complement

We have performed light transmittance measurements for two kinds of holes' arrangements; first, an array of 5 μm holes separated by 5 μm and second, an array of 10 μm holes separated by 10 μm . The results can be appreciated in Figure S3. As expected the sample with bigger holes has higher transmittance from an average of 2 % in the 5 μm holes to an average of 7 % in the 10 μm one. We also performed the same measurements from the back of the sample to account for the roughness created after XeF_2 etching. As can be observed in the same figure, there is no apparent change in the transmittance due to the roughness.

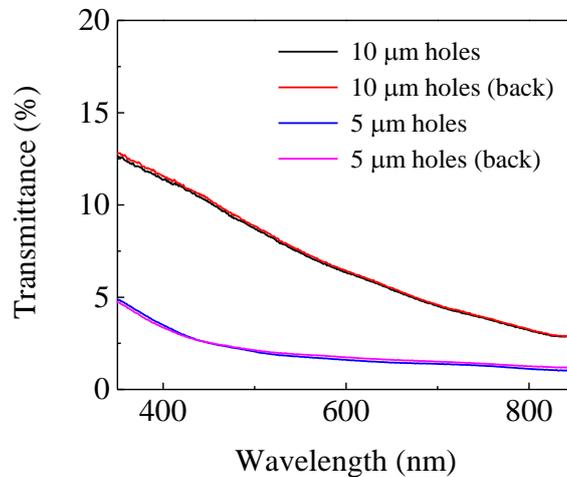


Figure S3. Light transmittance versus wavelength in the visible range for samples with different hole's sizes.