# Experimental Investigation of Carrier Velocity and Mobility in Deeply Scaled MOSFETs

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In this work we investigate the physical meaning of different MOSFET carrier velocity extraction methods, in order to measure appropriately how close to the thermal limit a modern MOSFET operates. It turns out that modern devices are operating at less than 50% of the ballistic limit.

There is a motivation to employ strained-Si and SiGe materials to enhance the mobility. However, the relationship between low-field effective mobility ($\mu_{\mathrm{eff}}$) and high-field carrier velocity is not well understood for deep-sub-100 nm MOSFETs. We have investigated this experimentally by mechanically inducing uniaxial strain, via a four-point bending apparatus, on devices with effective channel length down to 40 nm. Experimental results show that for both N- and P-type devices the ratio of the change in the velocity to the change in the mobility caused by mechanical strain is about 50-60% in deeply scaled devices.