Advanced data encryption using two-dimensional materials

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Advanced data encryption requires the use of true random number generators (TRNG) to produce unpredictable sequences of bits. TRNG circuits with high degree of randomness and low power consumption may be fabricated by using the random telegraph noise (RTN) current signals produced by polarized metal/insulator/metal (MIM) devices as entropy source. However, the RTN signals produced by MIM devices made of traditional insulators, i.e. transition metal oxides like HfO_2 and Al_2O_3, are not enough stable due to the formation and lateral expansion of defect clusters, resulting in undesired current fluctuations and the disappearance of the RTN effect. In this talk I will present the fabrication of highly stable TRNG circuits with low power consumption, high degree of randomness (even for a long string of 224-1 bits) and high throughput of 1 Mbit/s by using MIM devices made of multilayer hexagonal boron nitride (h-BN); we also demonstrate their application to produce one time passwords ideal for the internet-of-everything. The superior stability of the h-BN based TRNG is related to the presence of few-atoms-wide defects embedded within the layered and crystalline structure of the h-BN stack, which produces a confinement effect that avoids their lateral expansion and results in stable operation.

References

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Figures

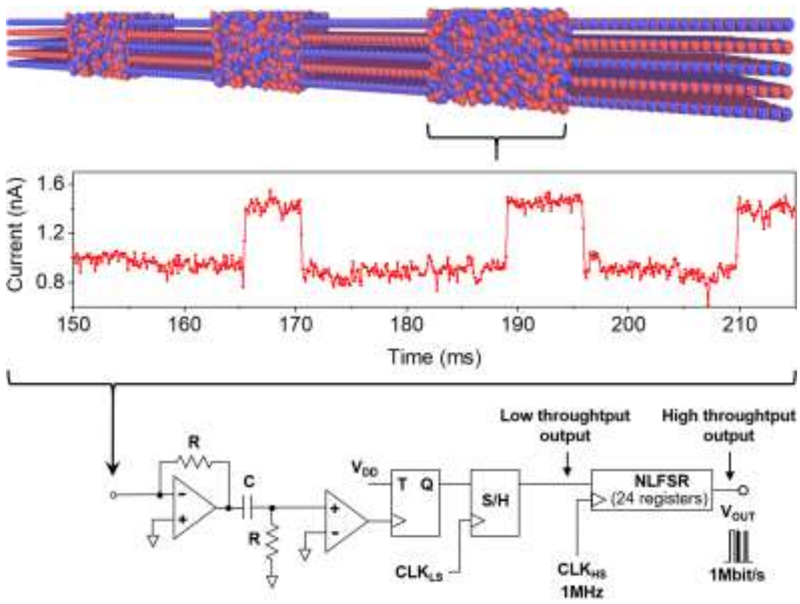

Figure 1: Top-view SEM image of a portion of a 100 x 100 crossbar array of Au/h-BN/Au memristors, each of them with a size of 320 x 400 nm. This is the 2D materials based electronic circuit with a highest number of electronic devices and with a highest integration density ever reported to date.