Vertically aligned hexagonal boron nitride for memristive applications

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Memristors are two-terminal electronic devices with a metal/insulator/metal structure, in which the electrical resistance can be adjusted to two or more levels by applying electrical stresses[1]. These devices can find applications as non-volatile electronic memory (a direction in which there are already commercial products for a value of around 100 million USD by 2025, mainly as embedded memory for microcontrollers), as well as neuromorphic computing, data encryption and 5G/6G telecommunication (being these latter three research directions in experimental phase)[2]. More research in this area is needed to fulfil performance and reliability targets for each application. Many researchers are using 2D materials to build memristors, but that suffers from a transfer method[3-5]. Here we show that plasma-enhance chemical vapour deposition enables the synthesis of vertically aligned hexagonal boron nitride (hBN) directly at the back-end-of-line of silicon microchips at 300 °C[6]. This approach is interesting not only because it is fully industry compatible, but also because the vertical hBN planes contribute to confine the migration of ions from the electrodes under an electrical field, which stabilizes the switching behaviour.

References

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Figure

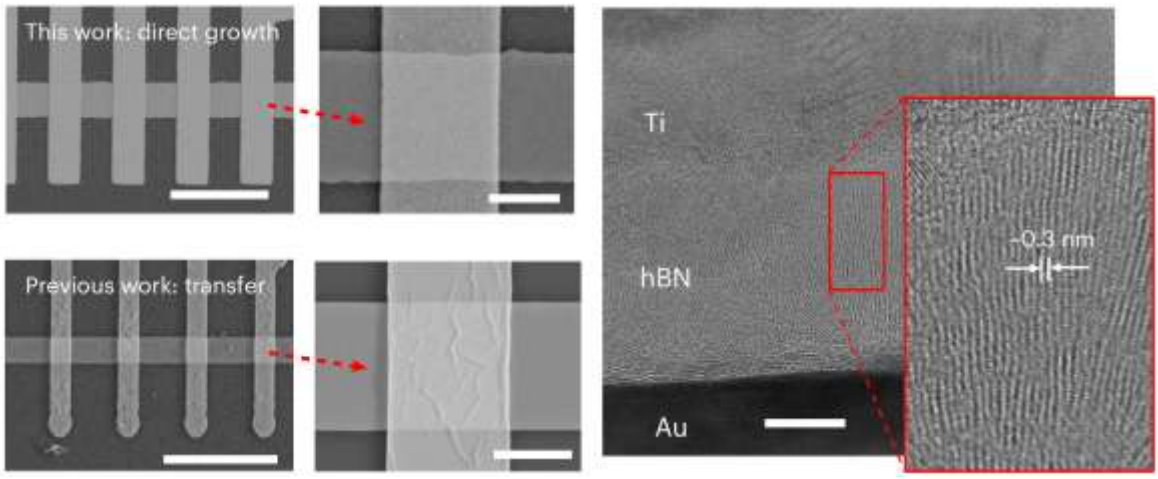

Figure 1: SEM images of hBN memristor arrays by direct growth (top) and transfer of hBN (bottom). Scale bars, 10 μm (array); 3 μm (high-magnification images). No wrinkles or contaminants are observed on direct-growth samples but observed on transferred samples/devices. d, TEM cross-sectional bright-field image of the Au/hBN/Ti memristor in which the hBN layers are shown to be vertically aligned. Scale bar, 10 nm.