4 inch Gallium Oxide Field-Effect Transistors Array with High-k Ta_2O_5 as Gate Dielectric by Physical Vapor Deposition

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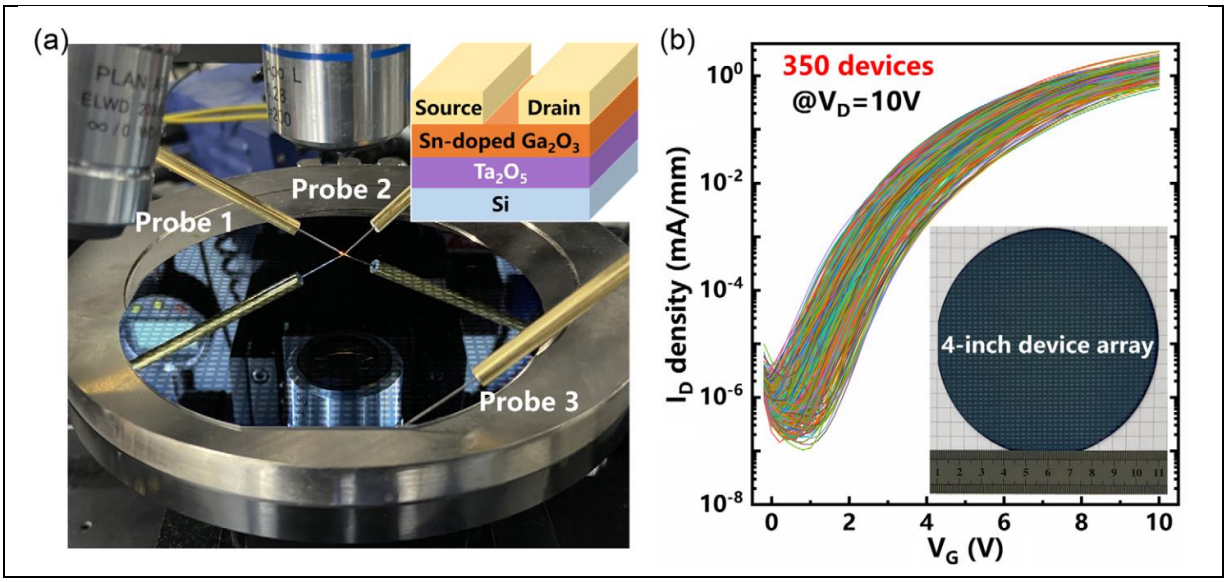
Field-effect transistors (FETs) with ultra-wide bandgap semiconductor Ga_2O_3 have been fabricated by physical vapor deposition with advantages of low cost, wafer scale, and rapid production. The insulator-like pristine Ga_2O_3 is converted to semiconductor by co-sputtering Sn with post-annealing, which demonstrates a 5.6×10^7 times higher on-state current. Importantly, this Sn-doped Ga_2O_3 sample shows a high breakdown voltage near 500 V. Furthermore, a 4 inch array of Sn-doped Ga_2O_3 FETs with high-k Ta_2O_5 gate dielectric has been fabricated on a silicon substrate, successfully showing a large on-current density of 1.3 mA mm^{-1}, a high I_{ON}/I_{OFF} of 2.5×10^6, and a low threshold voltage of 3.9 V, which are extracted from the average 350 devices. This work paves a promising way for Ga_2O_3-based nanoelectronics to serve medium-high voltage with low cost, rapid, and wafer-scale production.



(a) The photo of the fabricated 4 inch device array during data measurement. (b) Transfer curves of 350 randomly-measured FETs. The inset in (b) shows the 4 inch device array.