Edge-Contact Graphene FET Fabrication and Characterization : Opportunities for 2D Optoelectronics

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Abstract :

Metal-oxide-semiconductor (CMOS) transistor scaling is reaching its physical limits, particularly regarding energy consumption. Two-dimensional (2D) materials, such as graphene, offer promising alternatives due to their exceptional electrical and optoelectronic properties. However, integrating these materials into functional devices faces a major challenge : forming low-resistance electrical contacts with conventional three-dimensional (3D) electrodes. Edge contacts, where the metal interacts with graphene's atomic edges rather than its surface, have been proposed to significantly reduce contact resistance and improve device performance.

This work focuses on the fabrication and characterization of graphene field-effect transistors (gFETs) incorporating one-dimensional edge electrodes. The fabrication process includes key steps such as electron-beam lithography, thermal evaporation for metal deposition, and controlled transfer of 2D materials. To analyze the electrical behavior of these devices at the nanoscale, we utilize Kelvin Probe Force Microscopy (KPFM) to map the surface potential.

Experiments were conducted at the Nano'mat platform (Renatech+ Grand Est network) and the L2n laboratory. Preliminary results show a significant reduction in contact resistance, confirming the advantages of edge contacts over conventional top contacts. Further optimizations are underway to enhance the stability and reproducibility of these devices.

This work will be presented at the Graphene2026 conference in Barcelone, Spain.

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