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CONFERENCE  
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# Graphene Industrial Forum & 2DM 2020

## GRAPHENE WAFER SCALE INTEGRATION

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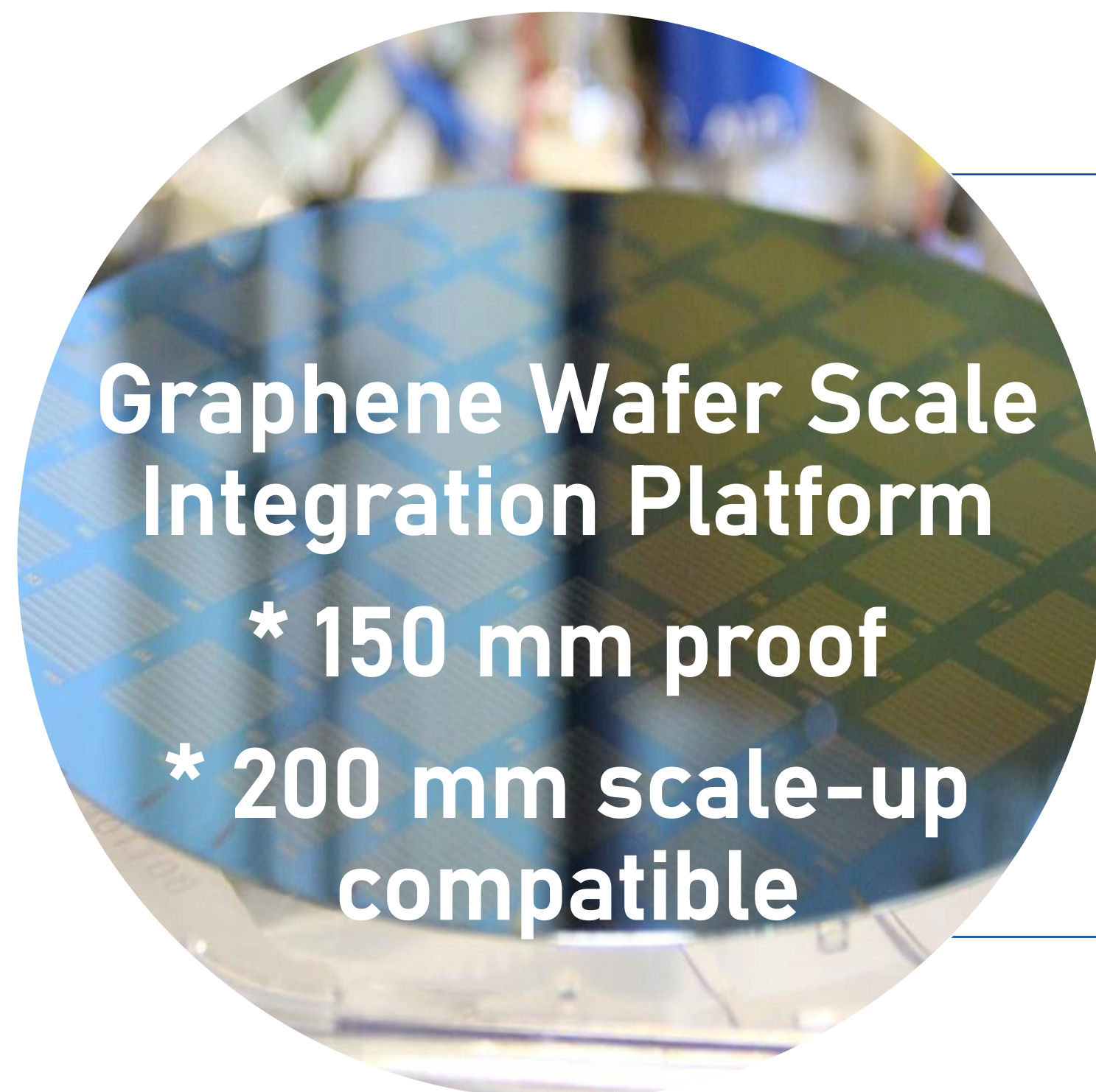
## Challenges

Graphene has allowed prototyping devices with exceptional performances and potentially huge impact in electronics, photonics and sensor technology. The next big challenge is the wafer-scale integration, as success in real-world applications requires not only outstanding performance at the single-device level but also, large-scale fabrication processes.[1,2]

## Goals

- Set up required process modules on a wafer scale platform including encapsulation, contacting and patterning.
- Define a quality control protocol and ensure batch to batch reproducibility.
- Manufacture of needed units for the graphene imager product development and validation.

## Solution: Graphene Fabrication Technology on 150 mm Wafer Platform



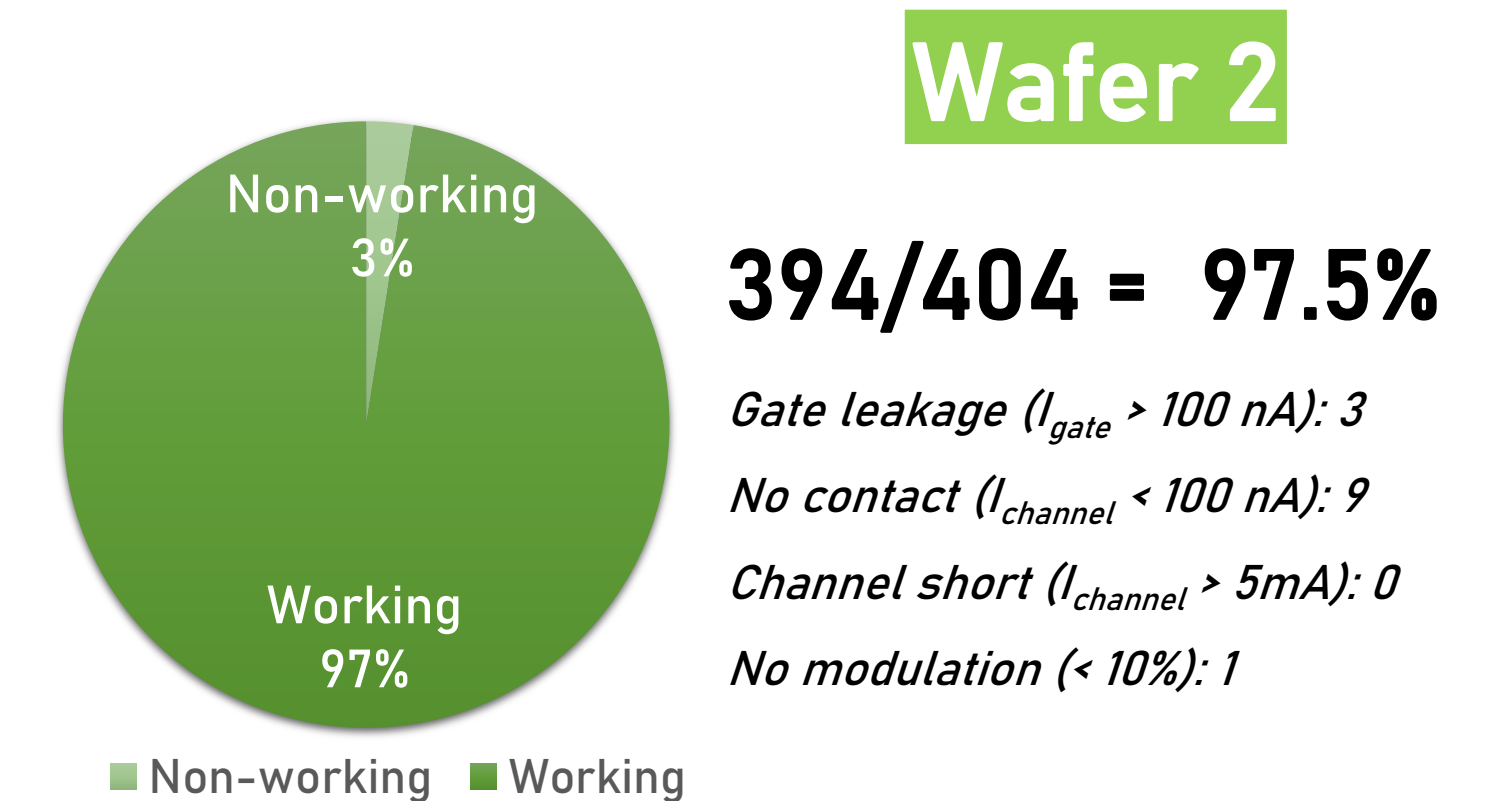
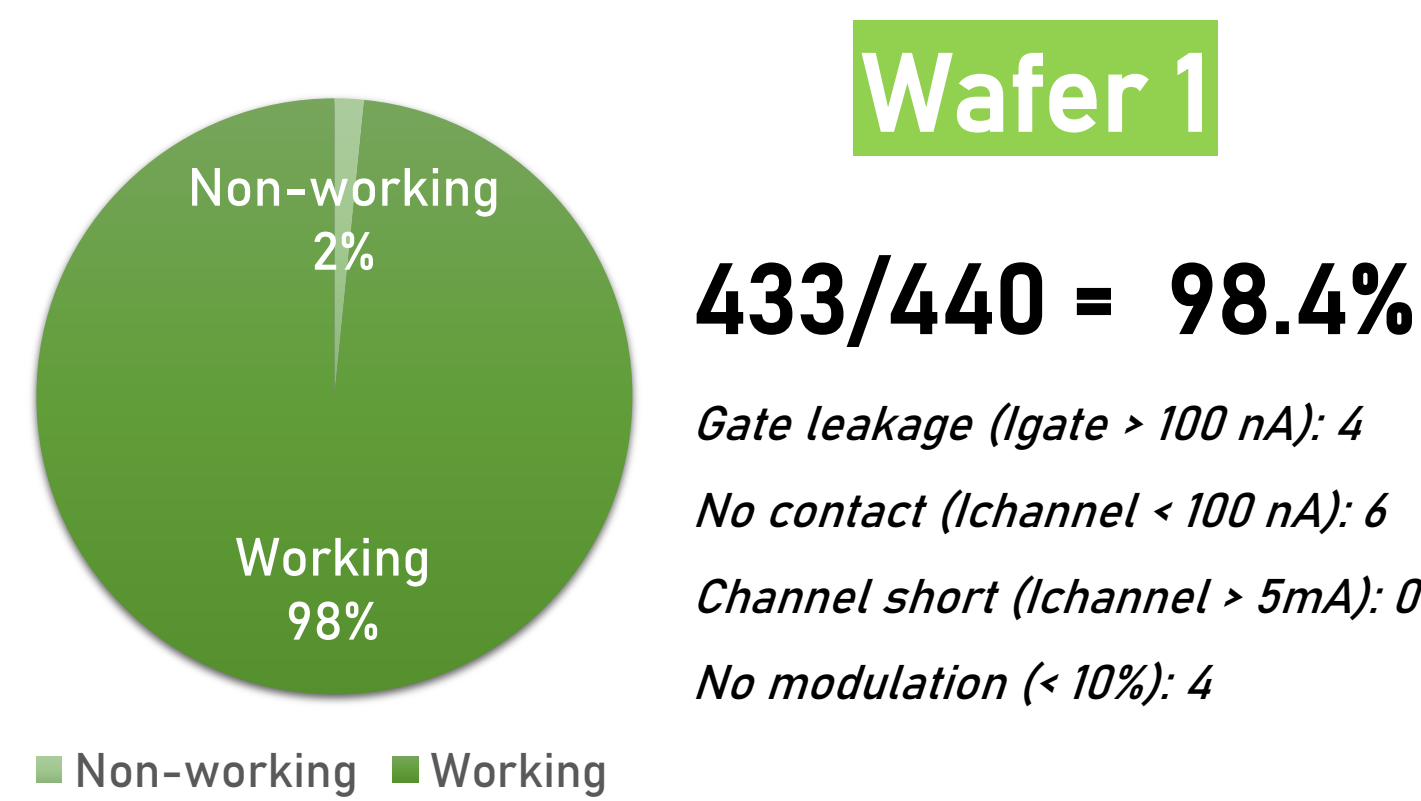
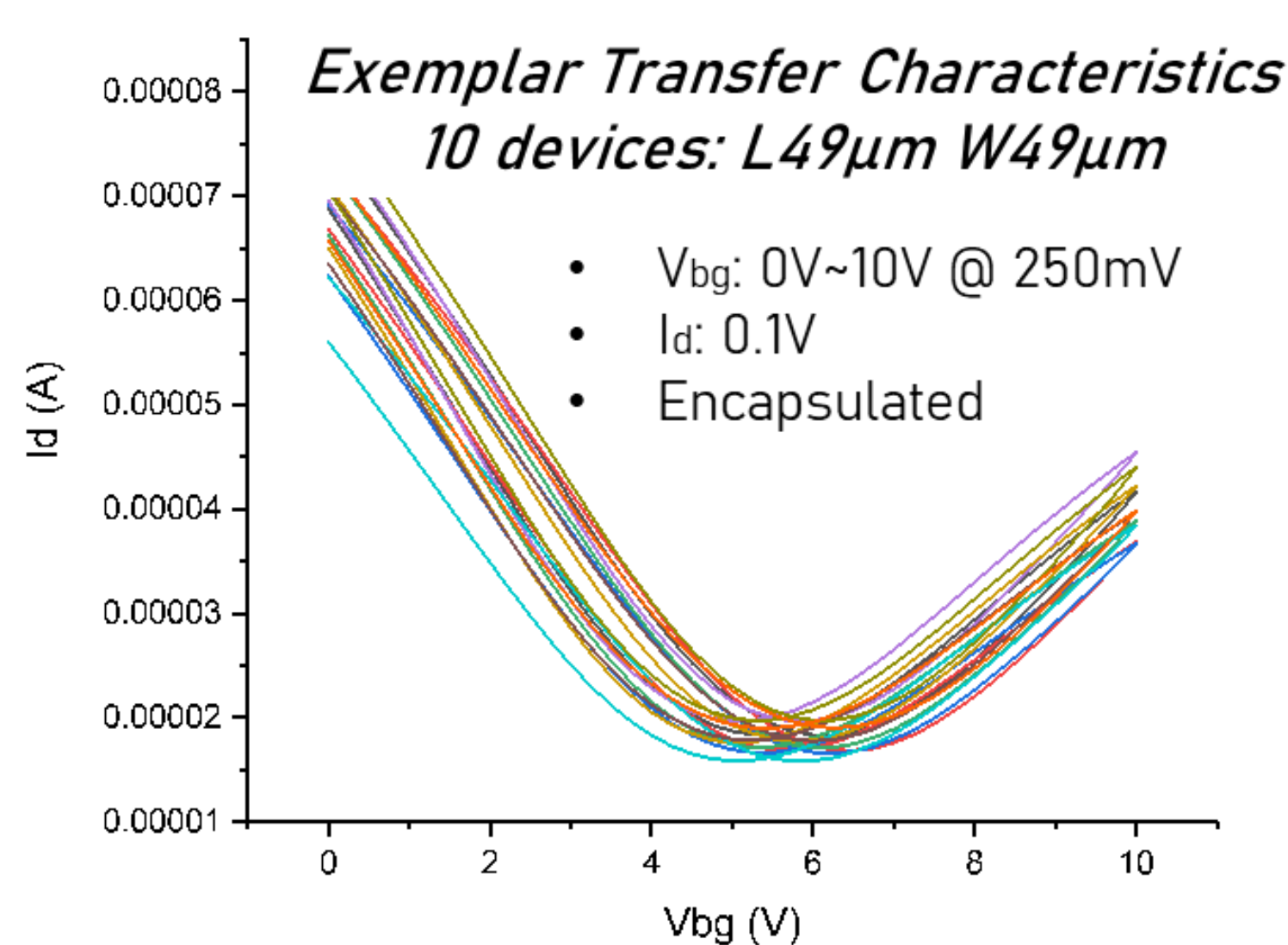
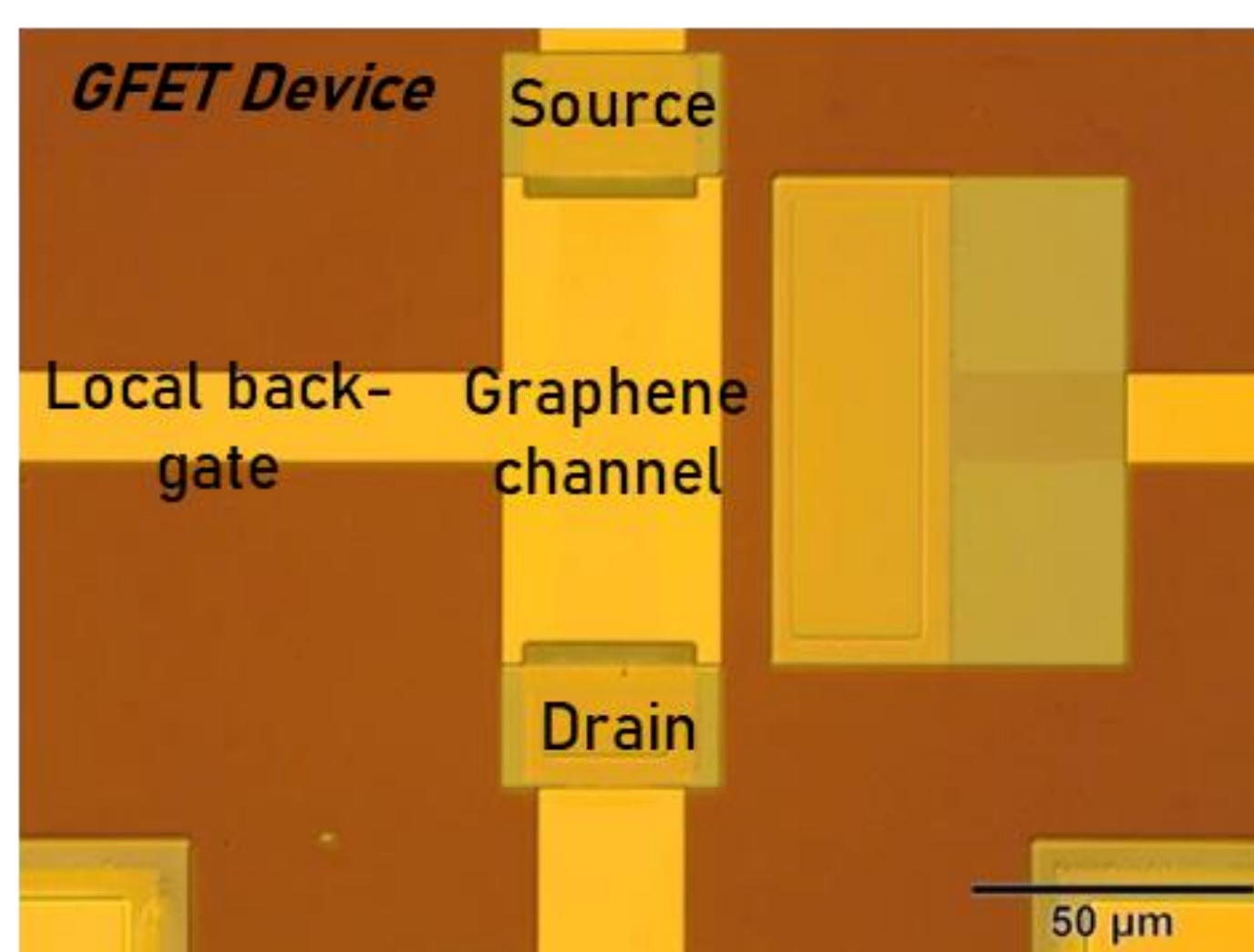
**Graphene Wafer Scale Integration Platform**  
\* 150 mm proof  
\* 200 mm scale-up compatible

Graphenea *Large Scale Growth and Transfer*

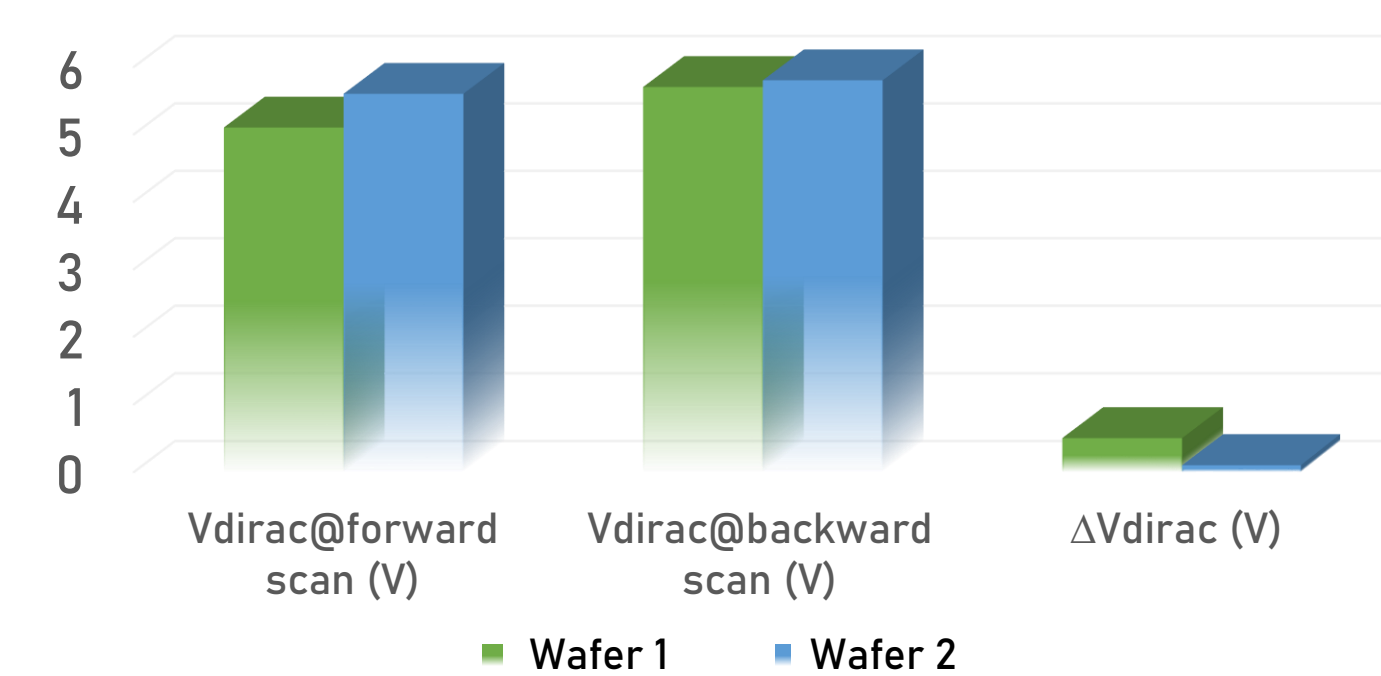
AMO *Graphene Foundry Process, including Patterning, Contacting, Encapsulation*

EMBERION *Imager Functionalisation*

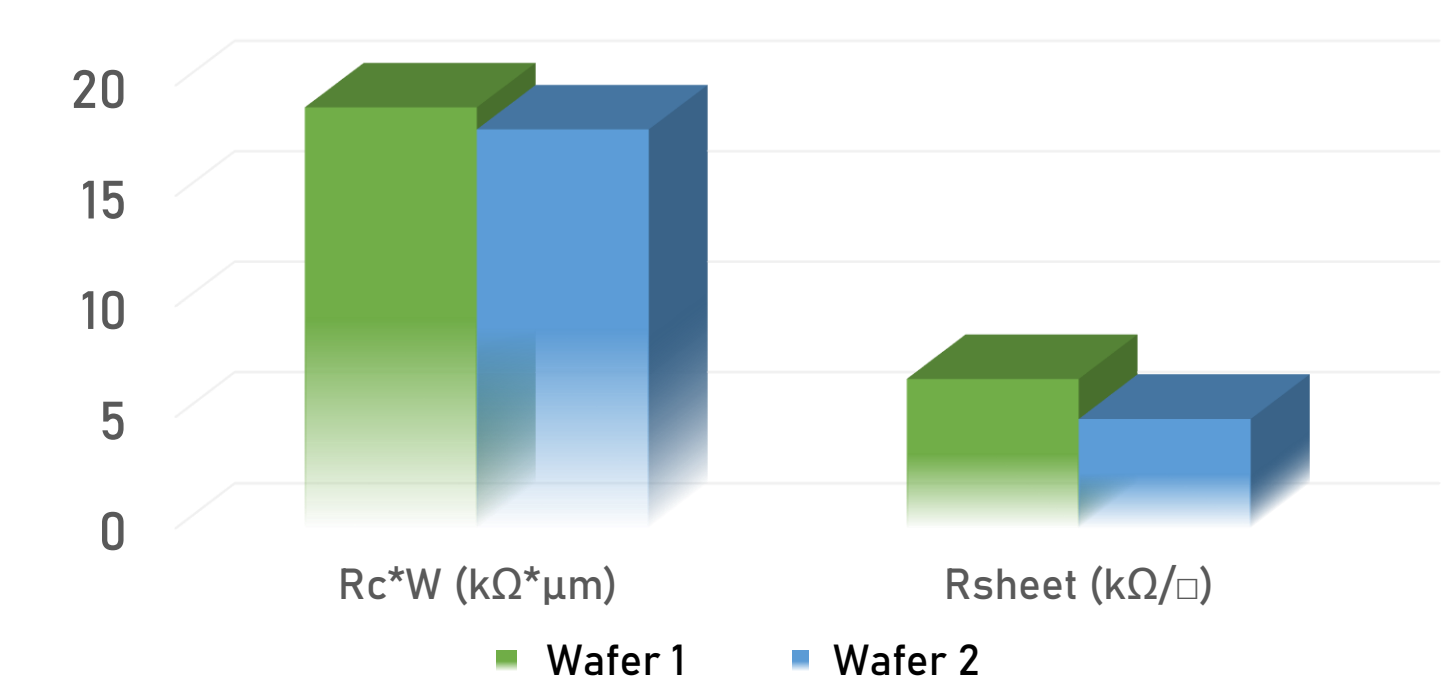
## Results: 150 mm Wafer Statistics of Local Back-gated Graphene FETs



### DIRAC POINT AND HYSTERESIS



### RESISTANCE



- ✓ Successful **integration** of graphene fabrication technology on 150 mm silicon wafer platform as a needed unit for a new graphene imager product
- ✓ Good batch-to-batch **reproducibility**, using **semi-dry** (wafer 1) and **wet** (wafer 2) transfer methods
- ✓ high device **yield of 98%**
- ✓ **Mobility: 800-1000 cm<sup>2</sup>/Vs**
- ❖ Promising for introduction of high-performing graphene-on-wafer at competitive cost, accelerating innovation for advanced 2DM-based electronics

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### REFERENCES

- [1] G. Fiori et al., Nat. Nanotechnol., 9 (2014) 768–779.  
[2] D. Neumaier, S. Pindl, M. C. Lemme, Nat. Mat., 18 (2019) 525–529.