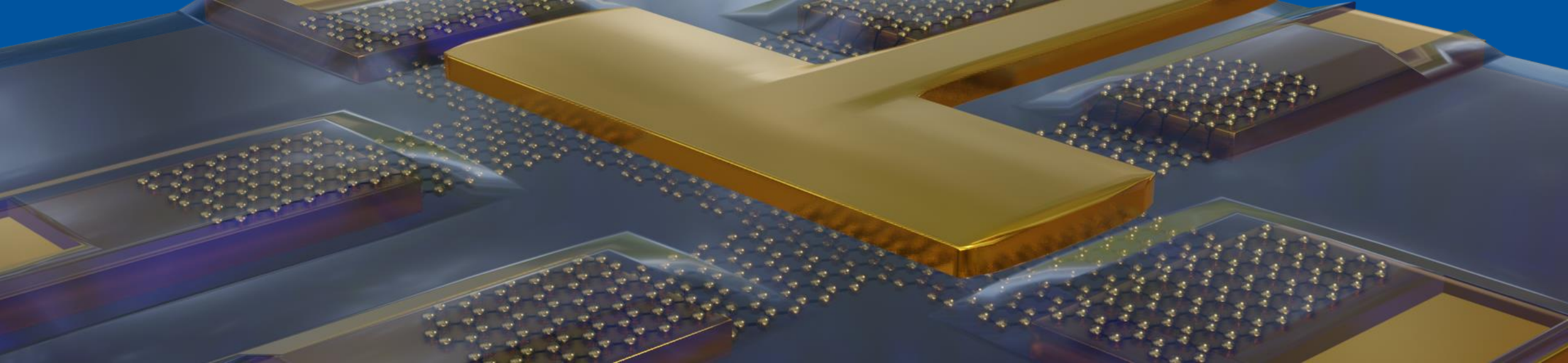




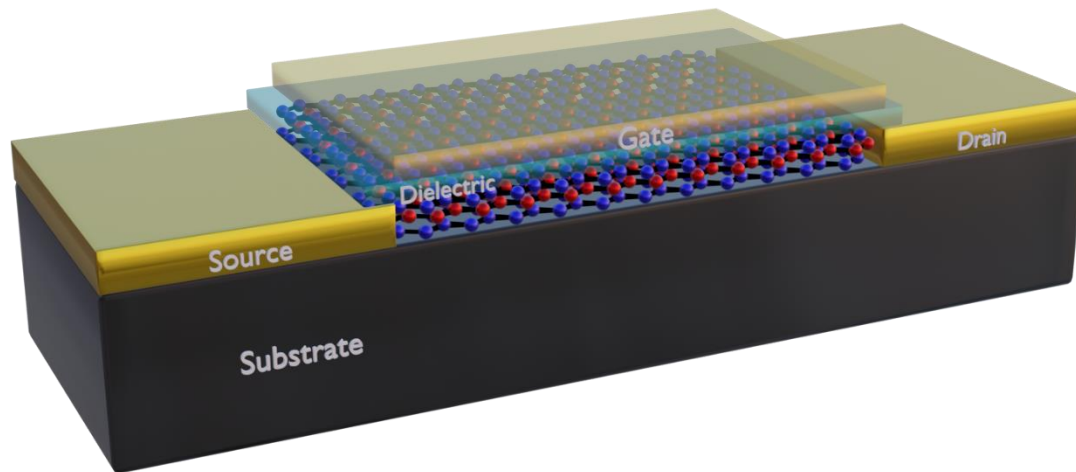
Damage-Free Plasma Enhanced Atomic Layer Deposition of AlOX Dielectrics for Tunable Doping of 2D Materials

Ardeshir Esteki, S. Riazimehr, A. Piacentini, H. C. M. Knoops, M. Otto, G. Rinke, Z. Wang, A. Grundmann, H. Kalisch, M. Heuken, A. Vescan, D. Neumaier, A. Daus and M. C. Lemme
SEMICON Europa
2024, Munich

2D materials present unique electrical and mechanical properties for next generation electronics.

High quality dielectric needed:

- High-k
- Low leakage
- High electric field strength



Problem

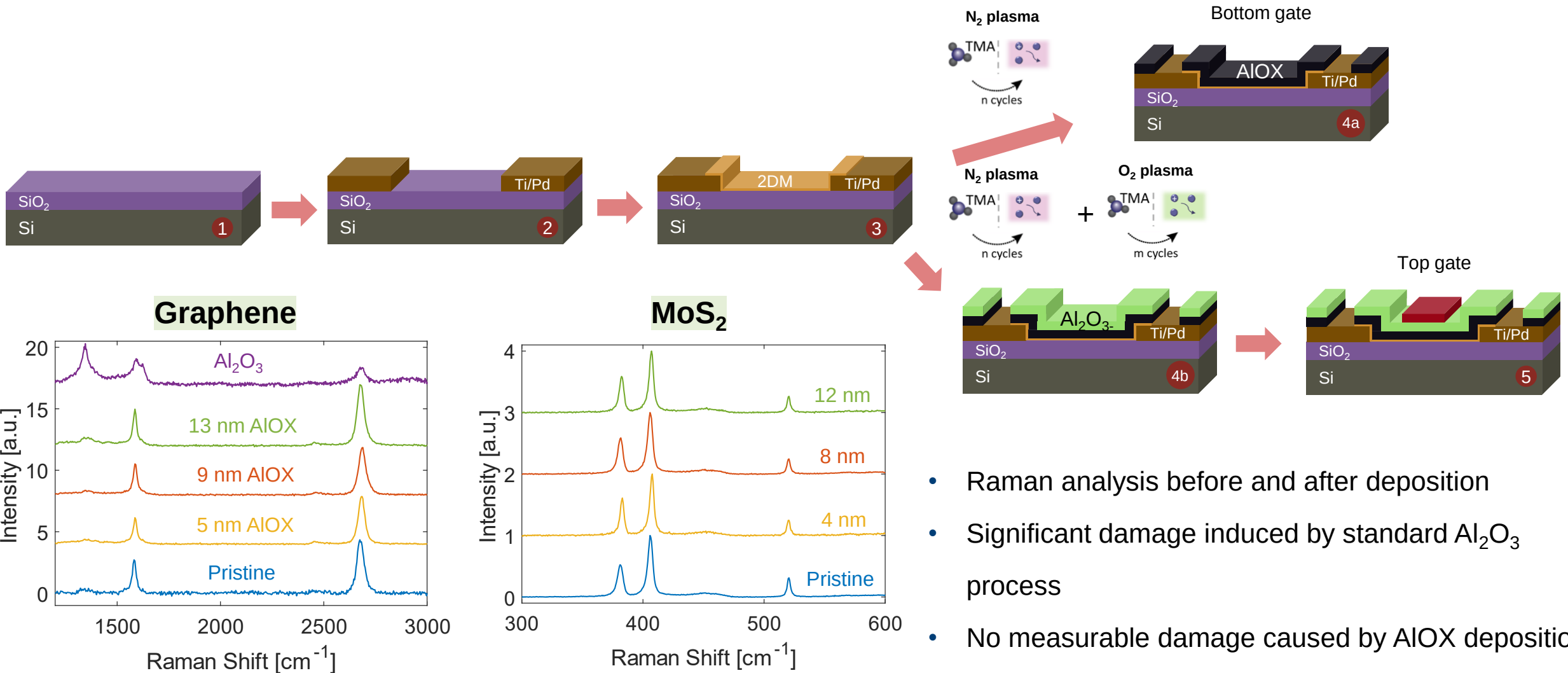
Controlling the doping of 2D materials
Deposition of high-quality films on 2D materials

Our Approach

Remote PEALD of high-k dielectrics directly on 2D materials

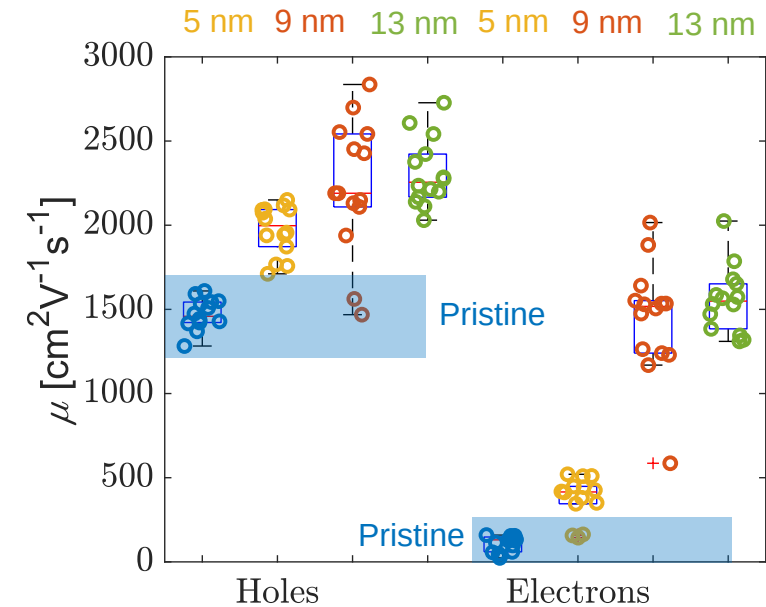
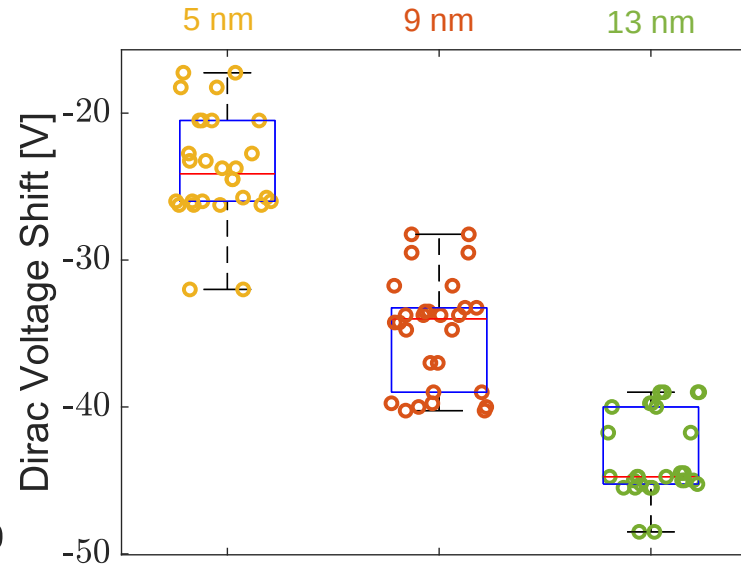
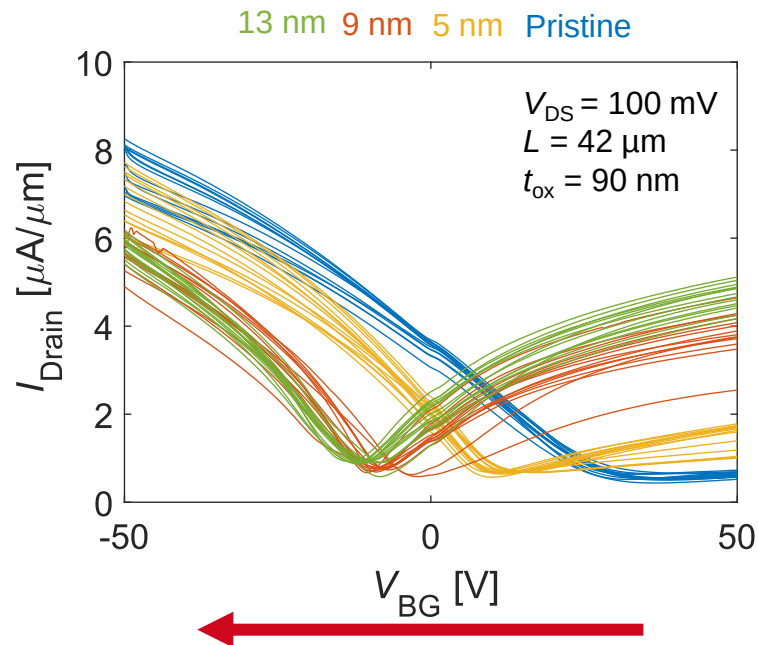
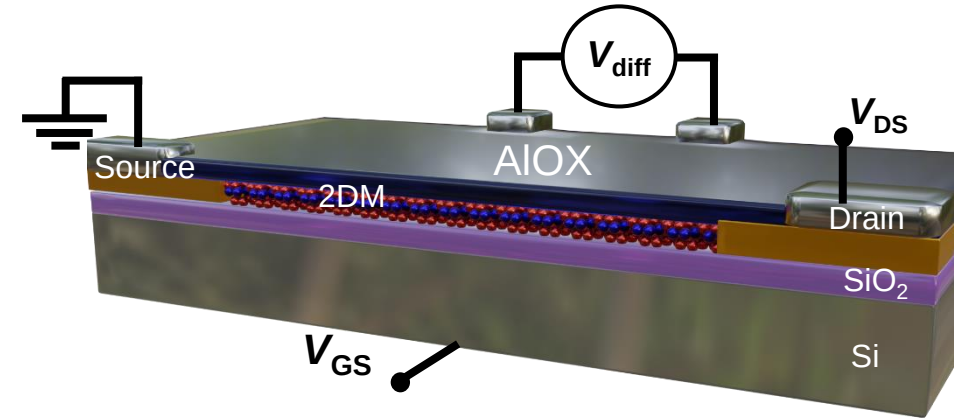
PEALD=Plasma Enhanced Atomic Layer Deposition

Remote PEALD – Fabrication Flow



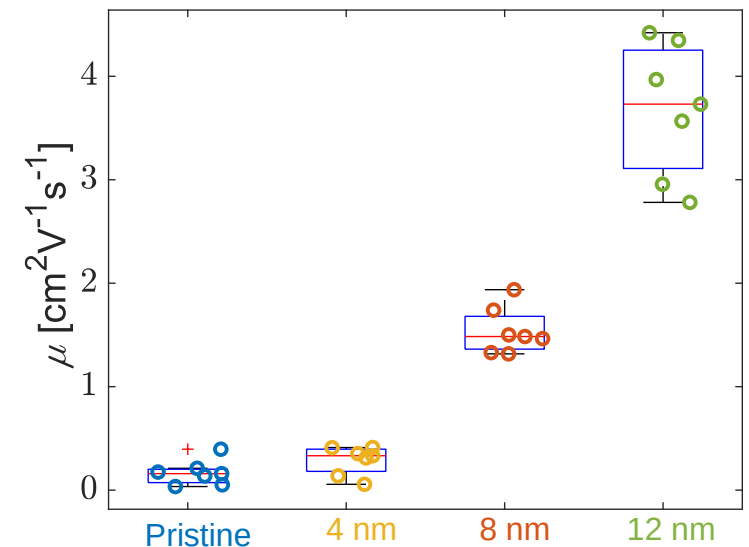
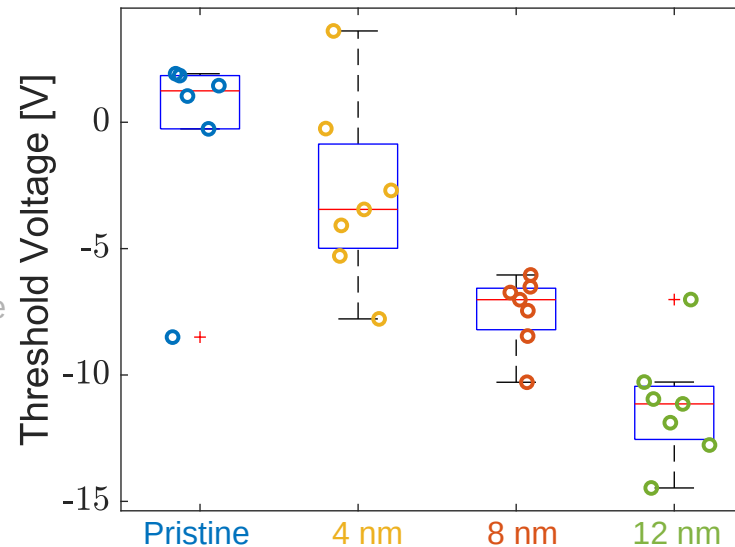
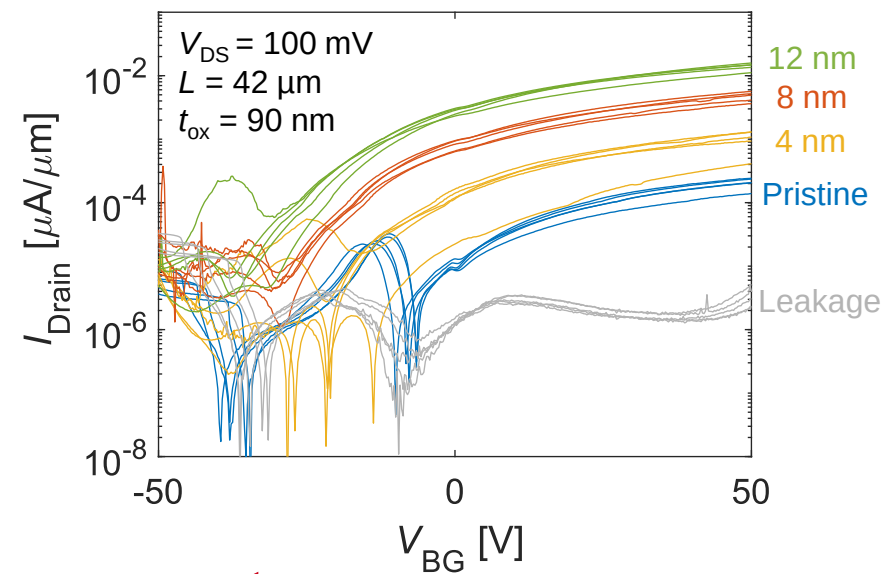
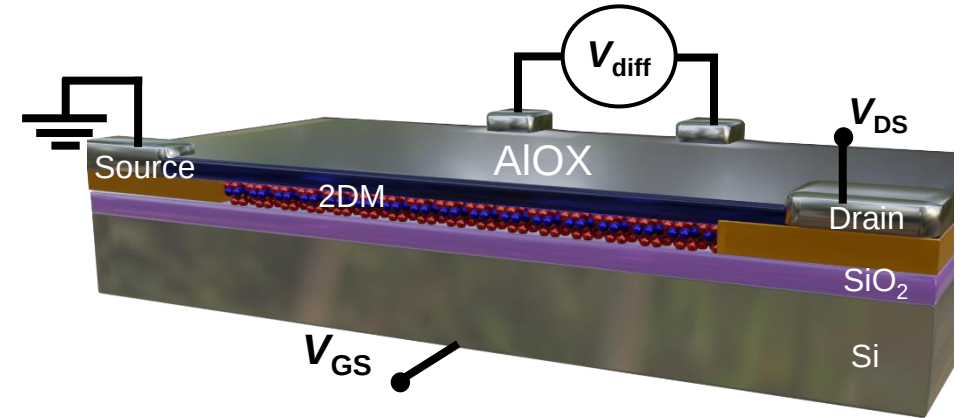
Remote PEALD – Graphene FETs Back Gated Measurements

- Different samples with 3 AIOX thicknesses
- Global back gated measurements in 4 probe configuration
- Mobility improved
→ Dirac Voltage Tuning



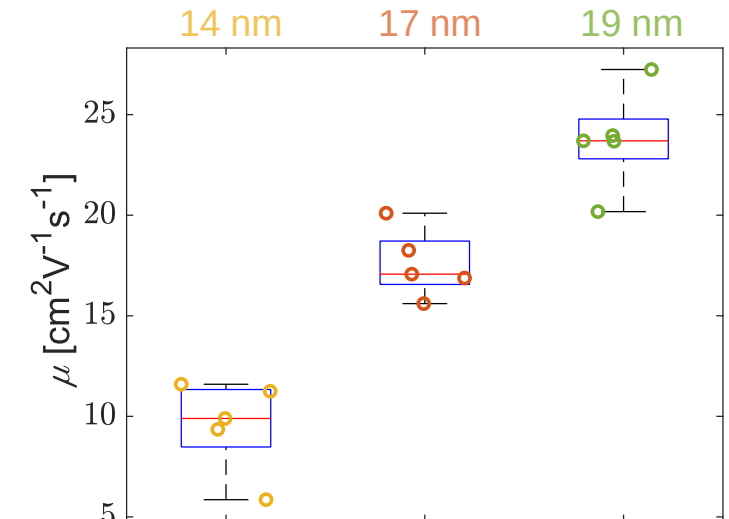
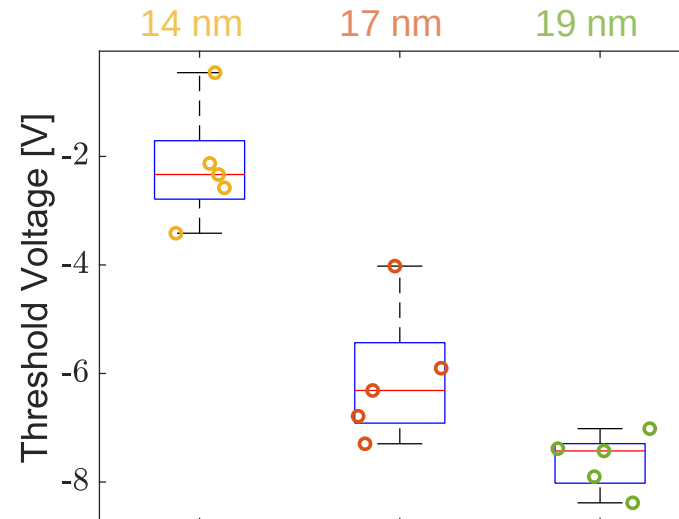
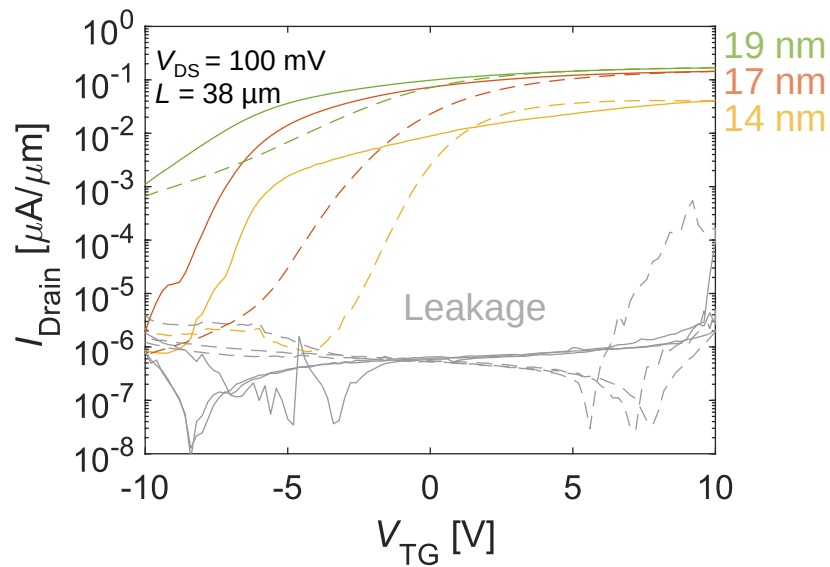
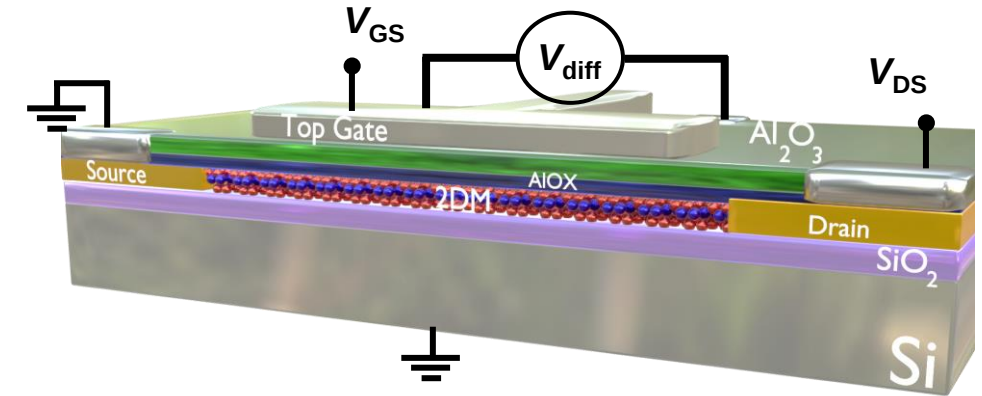
Remote PEALD – MoS₂ FETs Back Gated Measurements

- Different samples with 3 AIOX thicknesses
- Global back gated measurements in 4 probe configuration
- Mobility improved
 - Threshold voltage tuning



Remote PEALD – MoS₂ FETs Top Gated Measurements

- Different samples with 3 AlOX+Al₂O₃ thicknesses
- Top gated measurements in 4 probe configuration
- Mobility improved
→ Threshold voltage tuning



- **Scalable** and **damage free** PEALD for direct deposition of **high-quality dielectric** films on 2DMs.
- **Tuning** of the **Dirac** and **threshold voltages**.
- Top-gated graphene and MoS₂ FETs with **high electric field strengths**.
- New possibilities for the integration of modern electronics with 2DMs.

