

Graphene processing on Wafer Scale for Microelectronic Applications (GIMMIK)

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The aim of the ongoing GIMMIK research project is to expand graphene technology for electronic components and bring it up to production standards. In the GIMMIK project, the production of graphene layers is to be evaluated for the first time under industrial conditions. The weak points in the corresponding processing are identified and ways to eliminate the sources of error are being developed. In addition, the transfer of the properties of graphene to electrical components is to be tested by integration into a material environment. We report and discuss the progress and open challenges in the project.







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THz-TDS CHARACTERIZATION

- □ Wafer scale Graphene on Sapphire grown at AIXTRON
- Before transfer or lithography, near-field Terahertz Time Domain Spectroscopy (THz-TDS) was performed
- \Box Measurement step size ~ 200 µm

100

Average sheet conductivity of around ~ 0.5 mS/□



200



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GRAPHENE TRANSFER & RAMAN

- Chip scale Wet transfer of Graphene from sapphire using KOH solution
- □ Wafer scale transfer of 2" Graphene also demonstrated



Control Raman measurements at different points (red / blue / green) indicate no measurable change in graphene quality after the transfer process.





x [mm]

FABRICATED TEST DEVICES

- Edge contacted Graphene test structures fabricated on a 4" as-grown Graphene-on-Sapphire wafer
- possibility transfer: no of resist contamination and/or physical damage during graphene transfer
- **CMOS** compatible Ni metal contacts

Hall cross streuture



2100 rel_1/cm **On sapphire**

2000 2500 3000 3500 4000 4500 rel. 1/cm **On SiO₂/Si after transfer**

ELECTRICAL CHARACTERIZATION

 \Box Highest Hall mobility ~ 5600 cm²/V.s □ 35 devices characterized in ambient

□ Sheet resistance observed in the range of values suggested by THz-TDS measurements

• Point-to-point variability in graphene conductivity reflects in extracted parameters





Contact resistance [Ω.µm]	500 - 1000
Sheet resistance [Ω/□]	800 - 1350

ACCOMPLISHMENTS

- 2" and 4" Wafer scale growth of uniform sheets of Graphene on Sapphire demonstrated
- Successful clean, damage free wafer scale transfer to other substrate demonstrated
- Edge contacted Hall cross and TLM devices were fabricated at wafer scale

OPEN CHALLENGES

- overcoming large point-to-point variability in graphene conductivity
- extending similar growth-fabrication-testing to 8" wafers

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ACKNOWLEDGMENT

Support by BMBF (GIMMIK, 03XP0210) is gratefully acknowledged.





