European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

1ST TRAINING SCHOOL

Universitat de Barcelona, Spain, 13 - 15 June 2013

organized by UB, MIND-IN2UB - Dept. of Electronics and CSIC-IDAEA

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 1: 2012 - 2013 (*Ongoing Action*)

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COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Expertise of the Trainee related to the Action

- Background- Bachelor: Material Science and Engineering

  Master: Material Physics and Nanotechnology

3 yrs B.sc → **2 yrs M.sc** →

國立清華大學 材料科學工程學系 Department of Materials Science and Engineering

LINKÖPINGS UNIVERSITET TEKNISKA HÖGSKOLAN LINKÖPINGS UNIVERSITET

- Knowledge: Condensed matter/thin film/semiconductor physics, Characterization techniques(AFM, SEM…)

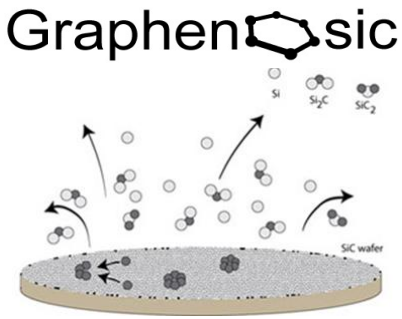
Interests in environmental pollutant issue..

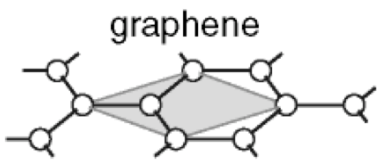
- CO_2 reforming by plasma
- CDIO- NOx sensor chip design and fabrication
- Advanced project-Thin nanostructure deposition on graphene

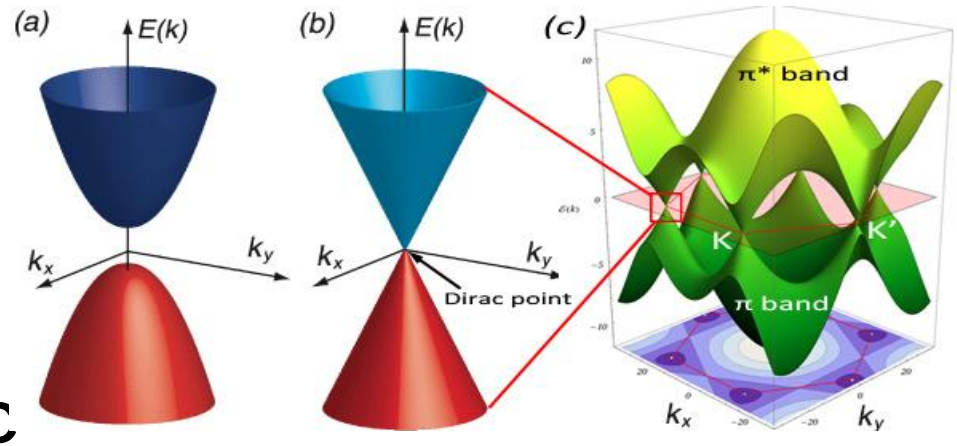
Current research activities of the Trainee (1/2)

Research topics in my group: Applied sensor science- MAX phase, Smart sensor operations, SiC-FET sensors…and

Highly sensitive graphene-based sensor toward wafer scale production





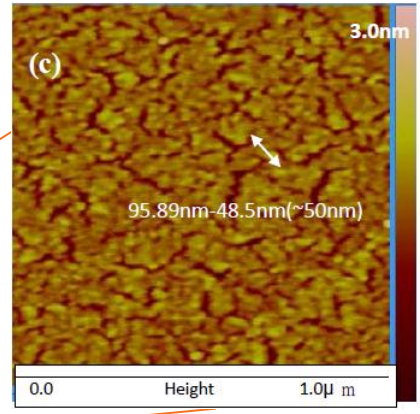


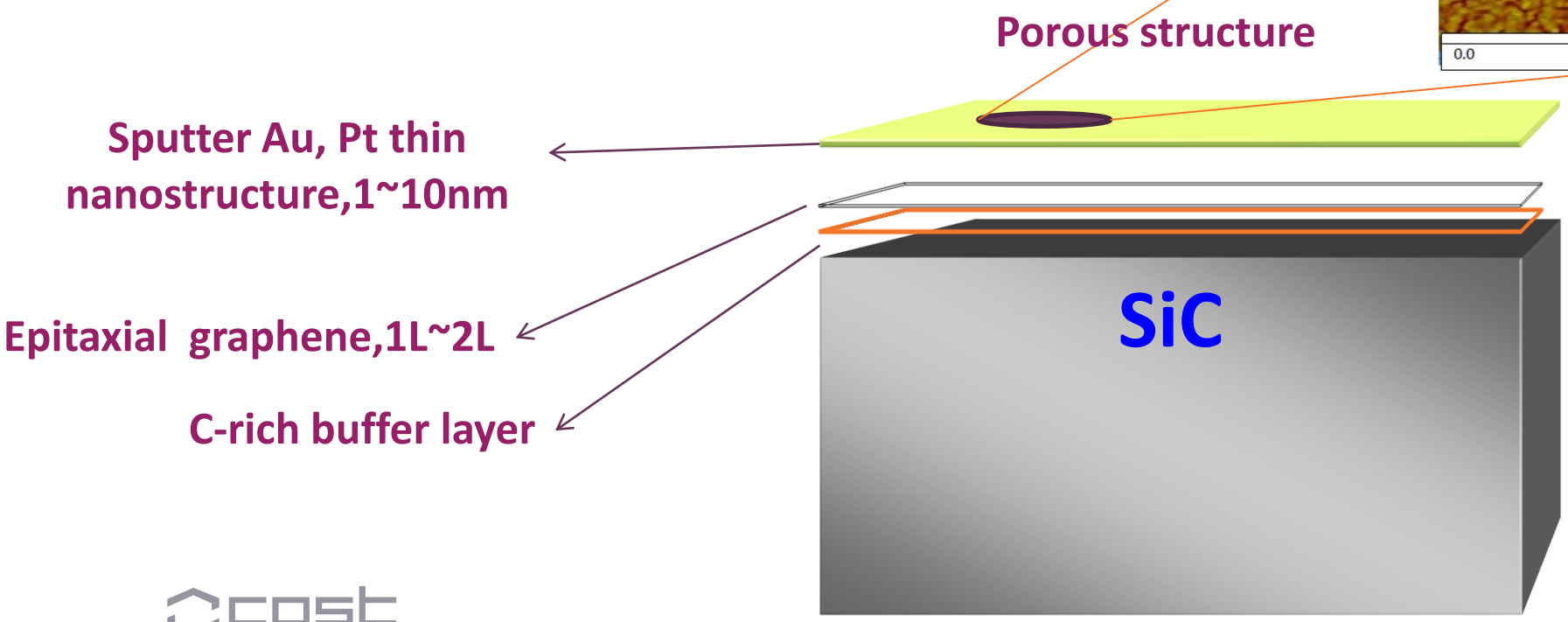
- **Epitaxial graphene on SiC**
- **Promising ppb level NOx detection (ppt, ppq level with UV cleaning)**
- **Challenges: sensitivity/selectivity, response/recovery times, reproducibility**

Current research activities of the Trainee (2/2)

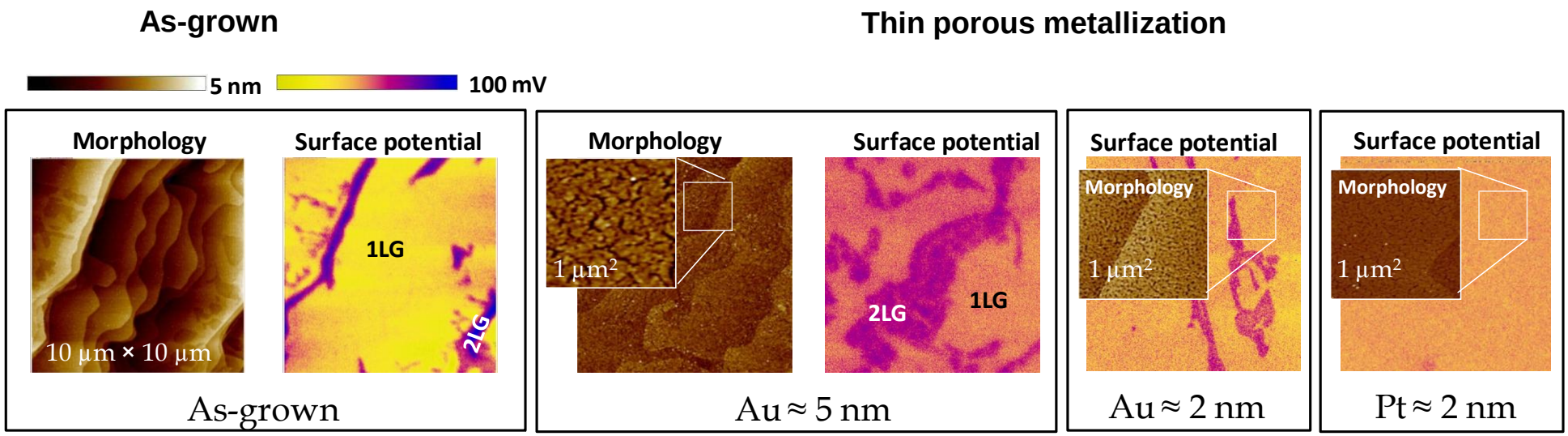
My ongoing research topics:

- **Thin surface metallization of graphene**
  - Deposition (Sputtering-reproducible way)
  - Characterization (AFM, SKPM,KP)
  - Gas testing (NO_2, NO, NH_3, CO, H_2)





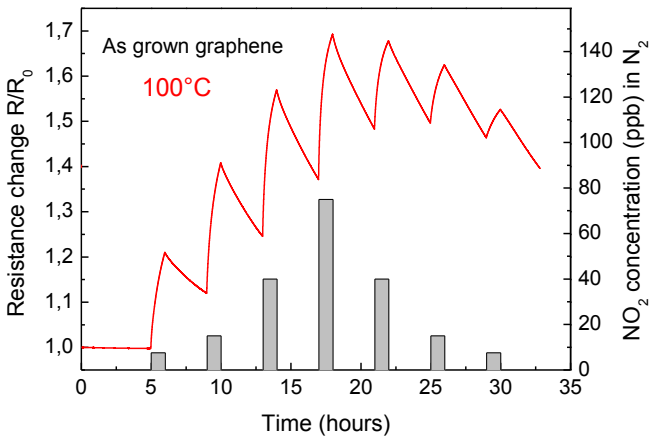
Achieved **RESULTS** and future activities



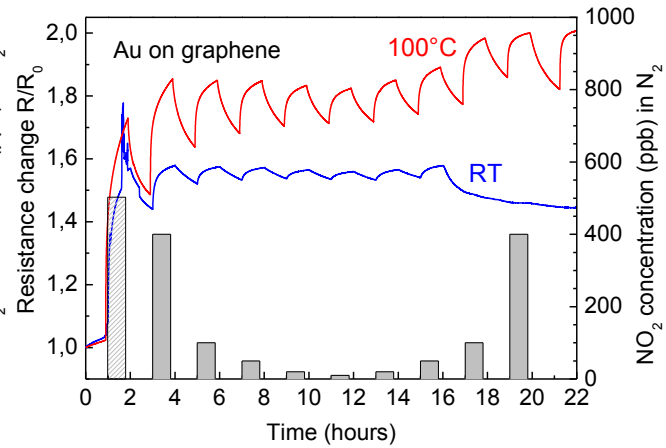
- Work function changes→We tuned the Fermi level of graphene(!!)
- New mechanism among graphene, gas, metal
- Surface properties remain those of graphene→Still sensitive

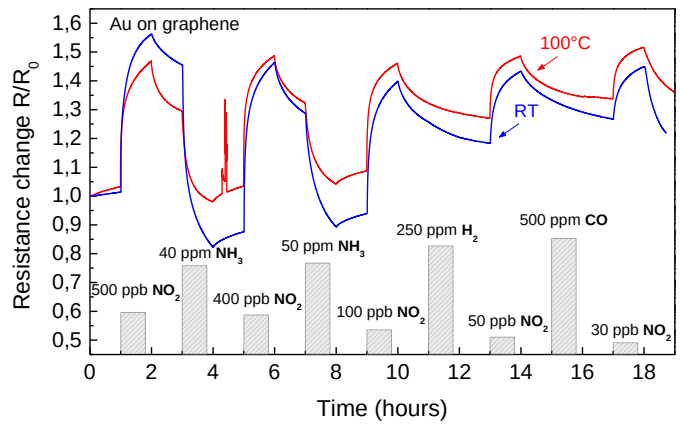
Achieved **RESULTS** and future activities

As-grown graphene



Au decorated graphene





Selectivity

Response to ppb concentrations of NO_2

- Improved response/recovery time
- Improved detection limit
- More stable baseline
- Suppressed response to NO/H_2 while maintaining NO_2 response (Au < 5 nm)

CONCLUSIONS

- Improving selectivity, speed of response/recovery time of EG/SiC sensor
- Toward controlled sensor properties of epitaxial graphene on SiC

- Future work-
- Optimize the deposition: thickness and structure effect
- Actual mechanism and reactions- XPS, MS
- Other material, e.g. Ir, VxOy…