Fabrication and Characterization of nanoelectronic devices

Clean room and Low temperature Laboratory
(Dr. Enrique Diez)

What we do?
• We design and fabricate micro and nano electronic devices in graphene and in III-V semiconductors.
• We perform magnetotransport measurements from 10 mK to room temperature up to 12 Teslas.
• We fabricate cryofree refrigerators with turnkey design and installation.

Funded Projects?
Sala limpia de nanotecnología de la Universidad de Salamanca: PCT-420000-2010-8
• Fenómenos no lineales y nanosistemas cuánticos. Aplicaciones en grafeno y otros sistemas de baja dimensionalidad FIS 2009 07880
• Nuevas Tecnologías Criogénicas aplicadas a nanodispositivos de Grafeno JCYL-SA049A10

Solar Cells and Terahertz laboratory
(Dr. Yahya Meziani)

What we do?
• We characterize solar cells electrically, quantum efficiency and efficiency.
• We perform detection and emission of THz radiation from plasma wave nanodevices.
• Time-domain spectroscopy and imaging in the THz range.

Funded Projects
Sistema español de espectросcopia y formación de imagen en Terahercios (MICINN-PPT-120000-2009-4)

Semiconductor Devices, TCAD & Characterizacion
(Prof. Dr. J.E. Velazquez)

What we do?
• Designing of new semiconductor devices for: low-power & RF/MW applications, THz, bio sensors, solar cells, … using TCAD.
• Materials: Si, SiGe, SiGeC, amorphous Si. Study by Monte Carlo/Tight Binding.
• Full electrical characterization: I-V, C-V and pulsed measurements.

Funded Projects
Si-based nanometric FETs: Performance at very large frequencies and thermal aspects (MICINN-TEC2008-02281)
Fenómenos no lineales y nanosistemas cuánticos. Simulation of Si-based FETs: THz behaviour and thermal transport (JCYL-SA061A09)
Theory of thermoelectric effects in nano-devices (MICINN FR2009-0030)
Graphene nanolithographic processing

Quantum hall effect and quantum phase transitions

Clean room and Low temperature Laboratory. Contact: E. Diez - enrisa@usal.es

Disordered graphene near Dirac Point

Graphene Transistors and quantum nanodevices

Cryofree refrigerators with turnkey design
Solar Cells and THz Laboratory
Contact: Yahya Meziani meziani@usal.es

Aims: R&D in advanced semiconductor structures for THz applications

A glimpse of the considered structures:

- Strained Si/SiGe n-MODFET
- Doubly interdigitated grating gates in III-V HEMT
- THz detectors based on Graphene transistors
Si/SiGe MODFETs used as sensors in THz signals detection

Si/SiGe MODFETs used as sensors in THz imaging
Solar Cells and THz Laboratory

Contact: Yahya Meziani
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Amorphous Silicon

Cristalline Silicon

Contact: Yahya Meziani
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Silicon

Graphs showing the relationship between Isolar (mA) and Power (mW) for different voltages.
Aims: Design of new semiconductor structures

Contact: E. Velazquez. js@usal.es

Nanotechnology for new solar cells: Re-design of black Si used in microfluidics to build up new solar cells in collaboration with TMEC (Thailand).

Main results: First prototype of solar cell fully characterized.

Si nanowires and arrays: Design of Si NW devices along with Imperial College London. Monte Carlo modelling of Monte Carlo (MC) electro-thermal transport with Institut d’ Electronique Fondamentale, CNRS-Univ. Paris-Sud (Orsay, Francia) y CINVESTAV, México DF.

Main results: Prototypes fabricated and tested by ICL. MC code under development.
Aims: Design of new semiconductor structures
Contact: js@usal.es

SiGe advanced transistors: Design of nanometric n-channel Si/SiGe MODFETs in collaboration with Dr. K. Fobelets@Imperial College London

Main results: ultra-low power GHz amplifier (ICL), first THz imaging and detection using a SiGe device (see THz Lab)

MuGFET for ultra-low power applications: Design of a embedded multi-gate SOI-FET in collaboration with Dr. K. Fobelets@Imperial College London

Main results: Prototype fabricated and tested. Redesign To be used as a ISFET in bio-sensing.
Facilities

Low Temperature Laboratory

- Triton (10 mK)
  Cryofree Dilution Fridge
  0.01 K - 30K

- Heliox (300 mK)
  Helium-3 Cryofree
  0.3 K - 300K

- Cryofree Superconducting Magnet 12 Teslas

- Baja Impedancia
  4 Lock-in amplifier SR830
  2 Source/meter Keithley 2612A
  1 Nanovoltimeter Keithley 2182

- Medidas Alta Impedancia
  Current source Keithley 6221
  2 electrometer Keithley 6514
Facilities

Clean Room

Optical Lithography
MJB4 Suss Mask Alligner
Submicron resolution
UV HG-XE LAMP 500W

UHV E-Beam Evaporator
Tecnovac Prototype
Au, Ti, Ge, Ni, Al, SiO₂

Oxygen Plasma Cleaner
Harrick Plasma

RTA- ULVAC 5000-P-N
Rate 50°C/s – up to 1200 °C

UV Optical Microscopy
LEICA DM 8000
BF, DF, ICR, UV, Oblique

2D Mechanical Profilometer
Leica critical point dryer
Probe station and micro-balance
Micro-Bonding station
Facilities

Solar Cells and THz Lab

Terahertz Spectroscopy System

THz-Time Domain Spectroscopy System: EKSPLA Spectrometer + Ti:Sapphire Laser (Spectra-Physics) THz imaging: Gunn Diode at 0.2TH + frequency tripler

Quantum Efficiency System

Solar Simulator

Solar simulator (several filters) and a system to measure both the internal and the external efficiency from Newport along with instrumentation (sourcemeters, lock-ins, …)
Facilities

Cascade Summit 11000B manual probestation with FemtoGuard® and Pureline™ technologies (200mm-chuck) + Agilent B1500 (4 SMUs, 1 multifreq CMU and 1 WG/EMU)

Semiconductor Devices

Semiconductor Analyzer

Synopsys

Full TCAD package from Synopsys (20 licenses)
Monte Carlo in-house code
Tight-Binding in-house code
Several work-stations and one cluster for intensive calculations
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  (Dr. Enrique Diez)

- **Solar Cells and Terahertz laboratory**
  (Dr. Yahya Meziani)

- **Semiconductor Devices, TCAD & Characterization**
  (Prof. Dr. J.E. Velazquez)

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