Photo-sensing Receivers using a-SiC: based materials

Visible Light Communication Systems

Manuela Vieira

The Eighth International Conference on Sensor Device Technologies and Applications
SENSORDEVICES 2017

September 10 - 14, 2017 - Rome, Italy

- **Manuela Vieira** was born in Lisbon, Portugal. In 1986 she received the Master of Science in Solid State Physics-Microelectronic and in 1993 the PhD in Semiconductor Materials both from the New University of Lisbon. She is a full professor since 2011 in Electronics inside the Department of Electronics Telecommunication and Computers (ISEL-Portugal) and the head of a Group in Applied Research in Microelectronic Optoelectronic and Sensors-GIAMOS in ISEL and another in Microelectronic, Material and processes-(M2P) in CTS-UNINOVA. She has several scientific papers and 30 years of experience in the field of thin films and devices, her research activities have been mainly related to the development of optical sensors .

- Research in the first phase (1987/1996) took place in “Centro de Física Molecular da Universidade de Lisboa”–CFM and “Centro de Excelência de Microelectrónica e Optoelectrónica de Processos “-CEMOP-UNINOVA. Research in the second and third phases takes place under her own coordination in “Grupo de Investigação Aplicada a Microelectrónica, Optoelectrónica e Sensores” (GIAMOS ISEL-DEETC) (1997/...) and in group “Microelectrónica Materiais e Processos (M2P)” in “Instituto de Desenvolvimento de Novas Tecnologias da Faculdade de Ciências e Tecnologia da Universidade de Lisboa”.

- **Other scientific activities**:
- Referee for international publications such as: Thin Solid Films, Material Research Society, Sensor Magazine, Sensor and Actuators, Material Science Fórum, Solid State Electronics, Vacuum, Applied Surface Science, Sensors and Transducers, Revista Ibersensors, Physica Status Solidi, Sensors, Journal of Nanoscience Nanotechnology, Journal of Sensors, Journal of Signal and Imaging Systems Engineering (IJSISE), etc.
- Referee for several EU projects as part of the Programme Growth “Innovative Products, Processes and Organisation“.
- Supervision and co-supervision of Master and PhD students
- Examiner for Master and Doctoral degrees.
- Authored and co-authored more than *300* publications in international journals cited in *“Science Citation Index”*. Presented more than *400* communications at conferences and seminars most of which with publication in journals and proceedings.

People

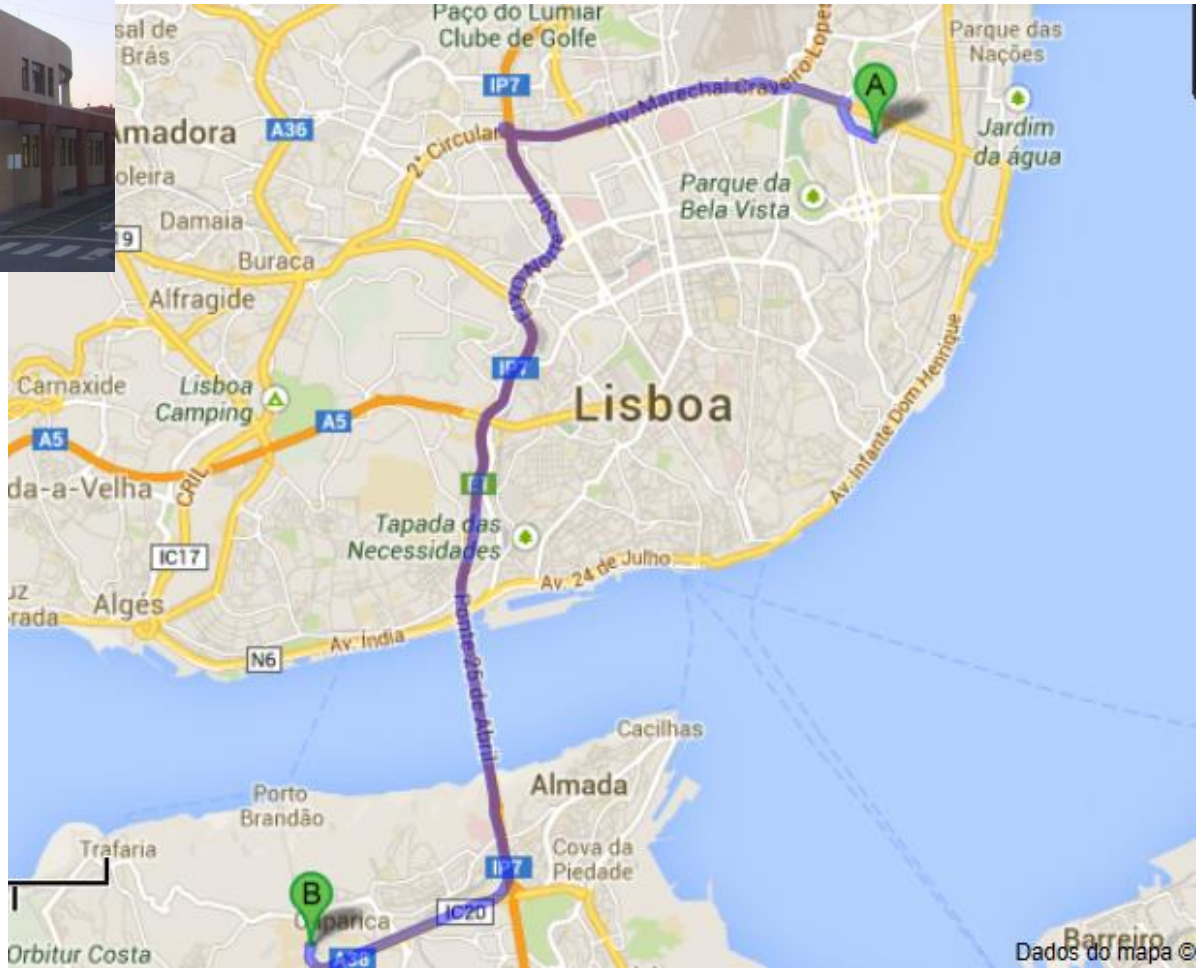
- **PhD members (9)**
- Manuela Vieira (Coordinator)
- Alessandro Fantoni
- Guilherme Lavareda
- João Costa
- Manuel Barata
- Manuel Vieira
- Miguel Fernandes
- Paula Louro
- Yuriy Vygranenko

- **PhD students (5)**
- Dora Gonçalves
- João Martins
- Vitor Fialho
- João Mendes
- Vítor Silva

- **MSc students (5)**
- Ricardo Almeida
- João Reis
- Nuno Mendes
- Hugo Leão
- Fábio Cardoso

Location

Rua Conselheiro Emídio Navarro, 1
1959-007 Lisboa
Portugal



Objectives

- Development, optimization and application of semiconductor based devices: image and color sensors, optoelectronic devices, solar cells, optical amplifiers, biosensors, VLC devices, nanostructures and UV and IV detectors.

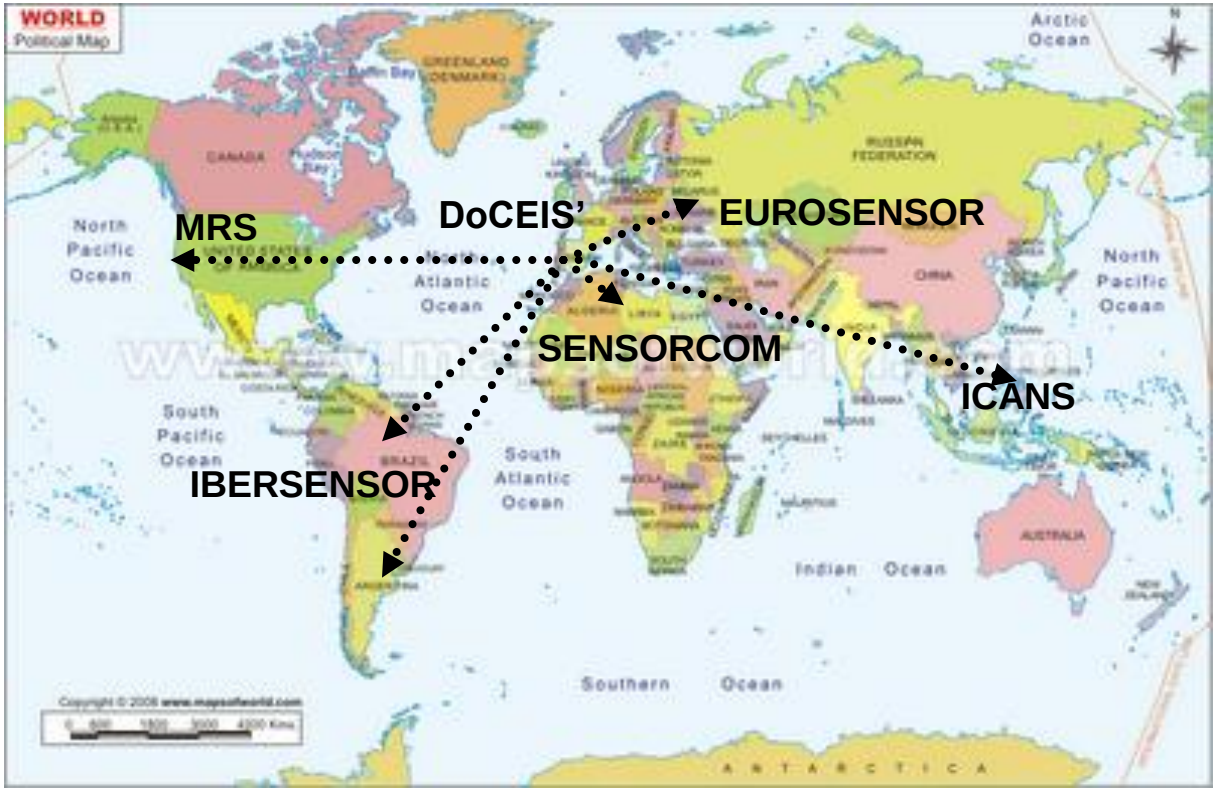
- Design and modeling of optical devices.

- Electrical and numerical simulation of optical devices.

- Integration of different technologies, namely optical sensors, wavelength-division multiplexing, Visible Light Communication, X-ray detectors and full digital medical imaging.

Dissemination

Abbreviated Journal Title
APPL PHYS LETT
IEEE T ELECTRON DEV
SENSORS and TRANSDUCERS
J APPL PHYS
J. NANOSCI. NANOTECH.



Publications

	Journals	Confer.	Book ch.	Patents
2012	14	10		2
2013	16	11		
2014	15	12	2	2
2015	14	9	2	
2016	16	10	5	
	75	**52**	**9**	**4**

Projects

- **Electronic transport and magnetic dynamics in low-dimensional magnetic systems and nanostructures**, IST-UTL, ISEL, Un. Évora, CFIF/IST/UTL, 109.188,00 €, Vitalii Dugaev
- **SDS silicon ribbons: a new path lo low cost photovoltaics,** FC-UL, INETI, ISEL, CFMC/UL,, 140.000,00 €, João Serra
- **Development of a biosensor based on ISFET system for assay of toxic amides,** ISEL, Un. Évora, CIEB/ISEL/IPL 81.000,00 €, Amin Karmali
- **X-Ray flat-panel detector for Medical Applications (MARx),** UNINOVA/FCT/UNL, ISEL, 120.000,00 €, Main Researcher: Luís Miguel Fernandes
- **Optical Biosensor based on FRET (OBIOS**, ISEL, UNINOVA/FCT/UNL, 135.000,00 €, Manuela Vieira
- **Wavelength Division Demultiplexing in the visible window using semiconductor devices**, UNINOVA/FCT/UNL, 373 214,00 €, Paula Louro Antunes

Technology Transfer

- Patents
  - G. Heiler, T. Tredwell, M. Bedzyk, R. Kerr, **Y. Vygranenko**, D. Striakhilev, Y. Hong, J. Lai, A. Nathan, ”High fill-factor sensor with reduced coupling”, European Patent Application EP2070121, Publication Date: 06/17/**2009**.
  - G. Heiler, T. J. Tredwell, M. D. Bedzyk, R. S. Kerr, **Y. Vygranenko**, D. Striakhilev, Y. Hong, J. C. S. Lai, A. Nathan, ”High fill-factor sensor with reduced coupling”, US Patent No.: 7,615,731 B2, Nov. 10, **2009**.
  - D.Striakhilev, A. Nathan, **Y.Vygranenko**, S.Tao, “Pixel having an organic light emitting diode and method of fabricating the pixel”, US Patent No.: 7,948,170 B2, May 24, **2011**.
  - Nathan, **Y. Vygranenko**, S. Jafarabadiashtiani, P. Servati, “Circuit and method for driving an array of light emitting pixels”, US Patent No.: 7,978,187 B2, Jul. 12, **2011**.

Conferences / Editorial Services

- Members of scientific committees
  - **IBERSENSOR**, Ibero-American Congress on Sensors: 2008 (Rio de Janeiro), 2010, 2010) (Lisbon), 2012 (Porto Rico)
  - **CETC**, Conference on Electronics, Telecommunications and Computers: 2011, 2013, 2017
  - **DOCEIS**, Doctoral Conference on Computing Electrical and Industrial Systems, 2009-1017

- Organization of conferences:
  - **IBERSENSORS 2010**, 7th Ibero-American Congress on Sensors ISEL, Lisboa, (November, 9-11, 2010), http://portugal2010.ibersensor.org/.
  - **CETC 2011,** Conference on Electronics, Telecommunications and Computers, ISEL, Lisboa, (November, 24-25, 2011), http://www.deetc.isel.pt/cetc11/.
  - **CETC 2013**, 2nd Conference on Electronics, Telecommunications and Computers, ISEL, Lisboa, (December, 5-6, 2013),
  - **CETC 2017**, 3nd Conference on Electronics, Telecommunications and Computers, ISEL, Lisboa, (December, 5-7, 2017), http://www.adeetc.isel.pt/cetc13/.

- Edition of a peer reviewed, online open access journal
  - **i-ETC (ISSN: 2182-4010)** Publication of original research and Electronics, Telecommunications and Computers-ETC

- Review of scientific papers for international journals
  - Plasmonics, Thin Solid Films, Sensors & Actuators, Sensors Journal, Vacuum, Solid state Electronics, J. Nanoscience and Nanotechnology, …

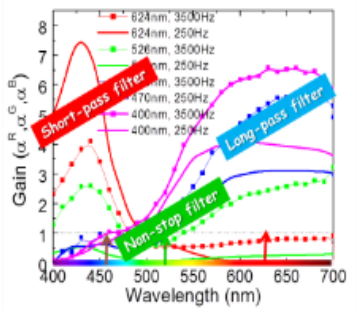
International Cooperation

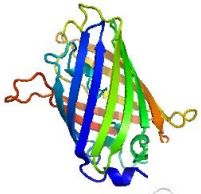
- Department of Electrical and Computer Eng., Waterloo, Canada.
- Giga to Nano Electronics Group, Univ. Waterloo, Canada.
- University of Cagliari, Italy.
- IPE, Stuttgart University, Germany
- Institute of Semiconductor Physics, Ukrainian Academy of Science, Kiev, Ucraine.
- Institute of Physics, Polish Academy of Sciences, Warszawa, Poland.
- Institute of Molecular Physics University, Polish Academy of Sciences, Poland.
- Wurzburg University, Germany.
- Polish Academy of Sciences, Poland.

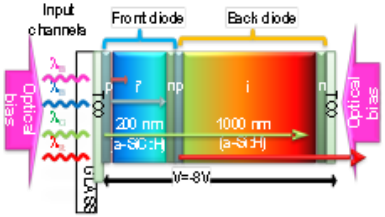
  - Production of semiconductor devices,
  - Characterization of materials and devices,
  - Joint publications (since 2006).

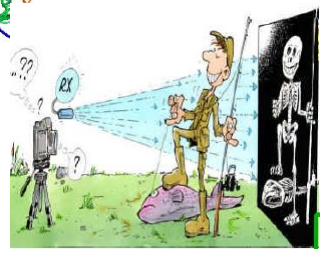
Main Research Areas/Projects

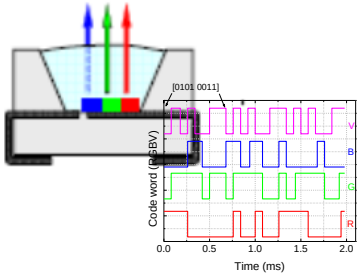
- Applications of semiconductor devices
  - Wavelength division demultiplexing
  - Optical biosensors
  - X-ray flat panel
  - Visible Light Communication
  - OLEDs











Swot Analysis

- 9 PhD members with different academic formation: physics, materials, electronics.
- Good Publication index in peer review journals and conferences.
- Strong connection to the academy: interaction with other institutions, many graduate students.
- High efficiency in concluded MSc.

- Increase the number of citations.
- Reinforcement of the collaboration with other national groups.
- Participation in European projects.
- Collaboration with the industry/companies.

What are we Pursuing/Aiming

- Generate cross fertilization with other national research groups;
- Increment the number of graduation students;
- Participation in European projects;
- Collaboration with industry/companies;
- Increase the number of patents.

Future

Investment in R&D is part of the solution to exit from the economic crises

The three priorities of H2020

1. "Excellent science"
2. "Industrial leadership"
3. "Societal challenges"

- Information and communication technologies
- Nanotechnologies
- Advanced materials
- Biotechnology
- Health
- Green and integrated transport
- Resource efficiency

Live Demo - Outline

- **Deposition facilities:**
  - Laboratories for support of Semiconductor Thin Film Development using the PECVD (Plasma Enhanced Chemical Decomposition) techniques.
  - Laboratories for support of Electronic, Optoelectronic and Microelectronic Device Processing.

- **Characterization facilities:**
  - UV-VIS-NIR and IR Spectrophotometers (Shimadzu),
  - dark/photo conductivity as a function of temperature;
  - spectral response;
  - Flying Spot Technique-FST;
  - Photothermal Deflection Spectroscopy-PDS;
  - Space Charge Limited Current-SCLC;
  - C(T)/C(V) measurements,
  - Coatings uniformity test-bench,
  - Characterization systems for devices (IV characteristics; annealing test chambers; degradation tests; interface characterization; Electroluminescence) and Solar simulator for small areas.
  - Spectrometers (UV, VIR, NIR, IR) and
  - Optical Characterization Systems (I-V, C-V),
  - Electric Characterization Systems,
  - Material Testing Bench.

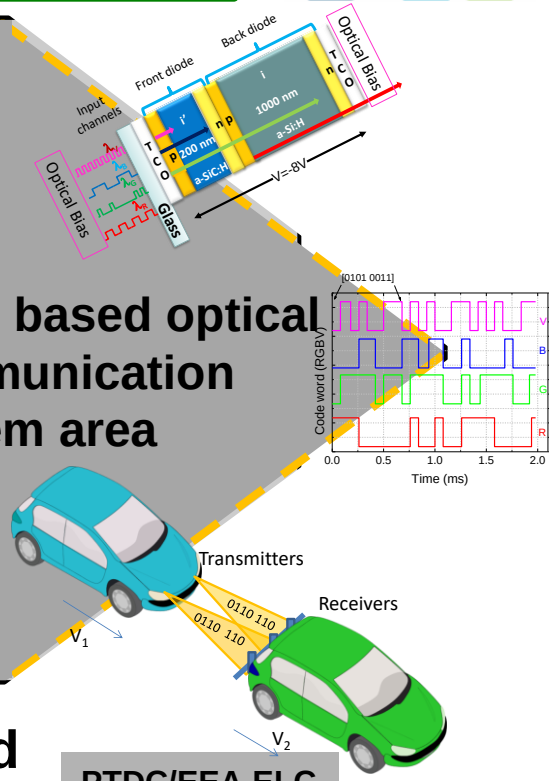
Running projects applications

Large area

Optical biosensor system

X-ray flat detector

WDM based optical communication system area



First project PTDC/EEA-ELC

FRET based prototype to detect fluorescence of the excited fluorophores when glucose is present, allowing to monitor its level.

Second project PTDC/EEA-ELC

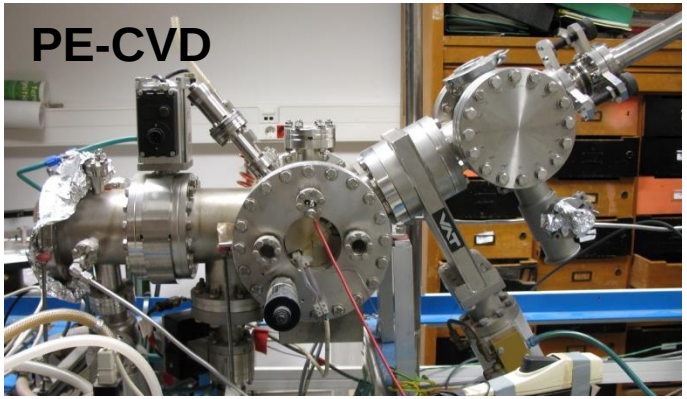
The use of Laser Scanned Photodiode (LSP) sensor is proposed for medical applications

Third project PTDC/EEA-ELC

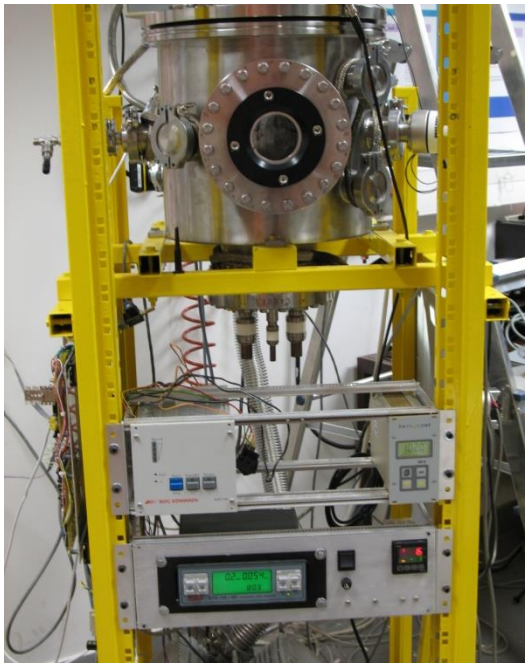
Short distance communication Systems. Digital city auto industry, medical sector and in-house communication

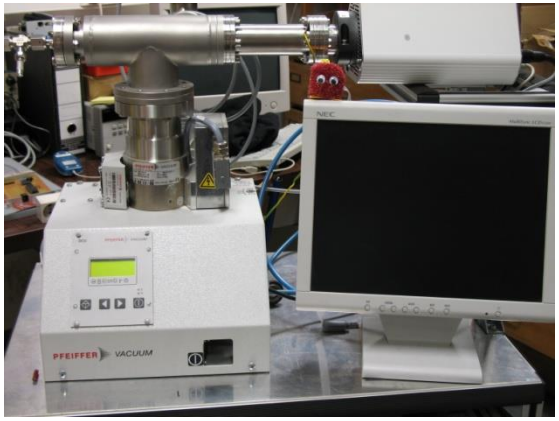
Deposition laboratory

PE-CVD



Thermal evaporation

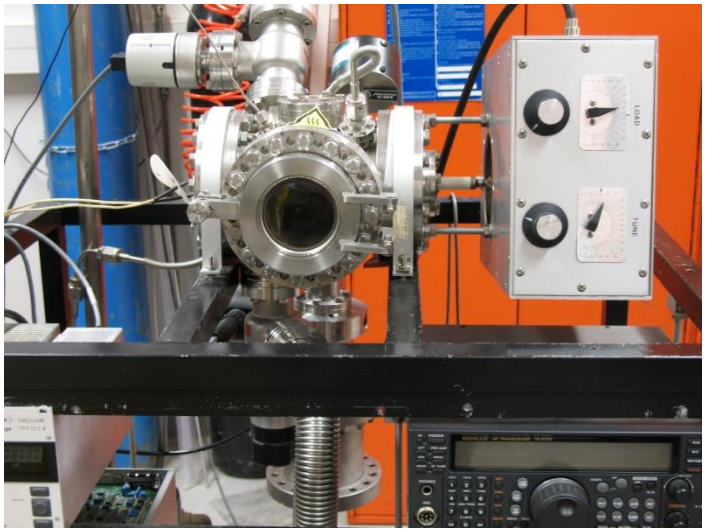




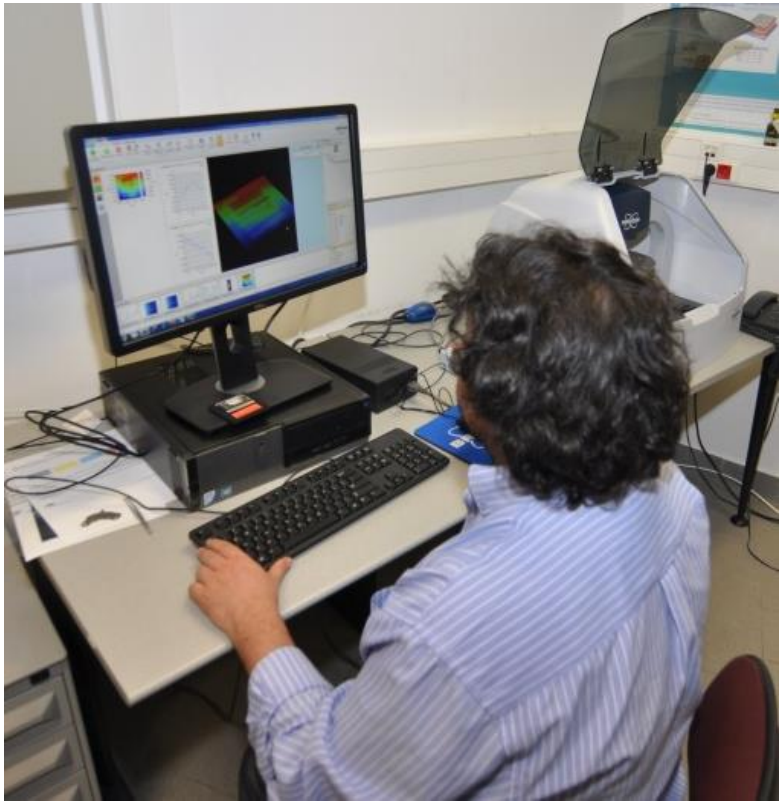
Mass Spectrometry

Spin coating

PE-CVD

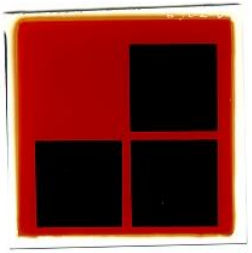


Material microstructure

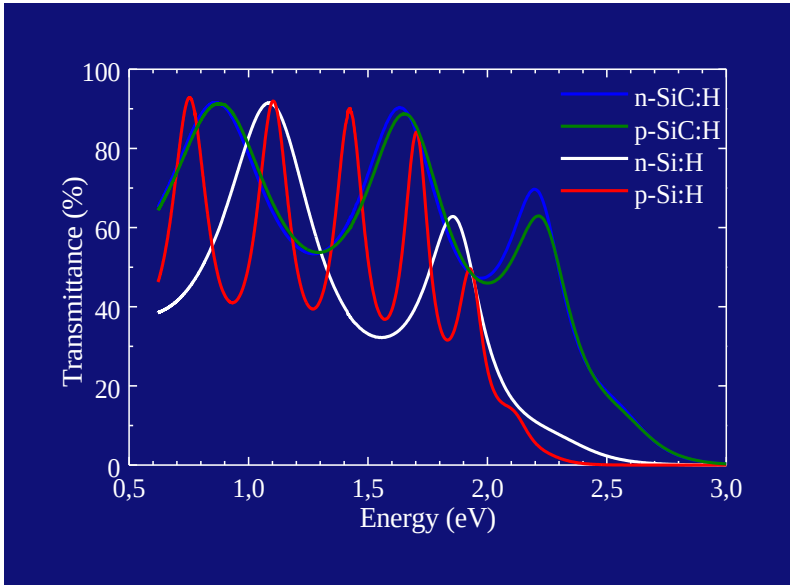


Dektak

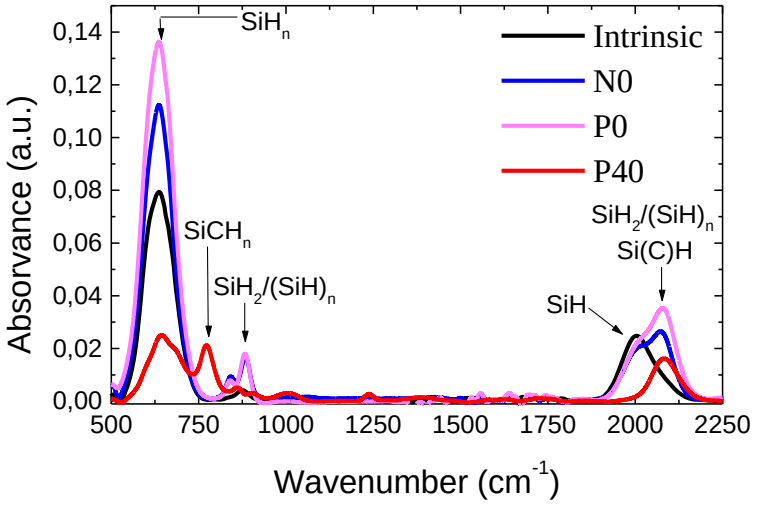
Microscope



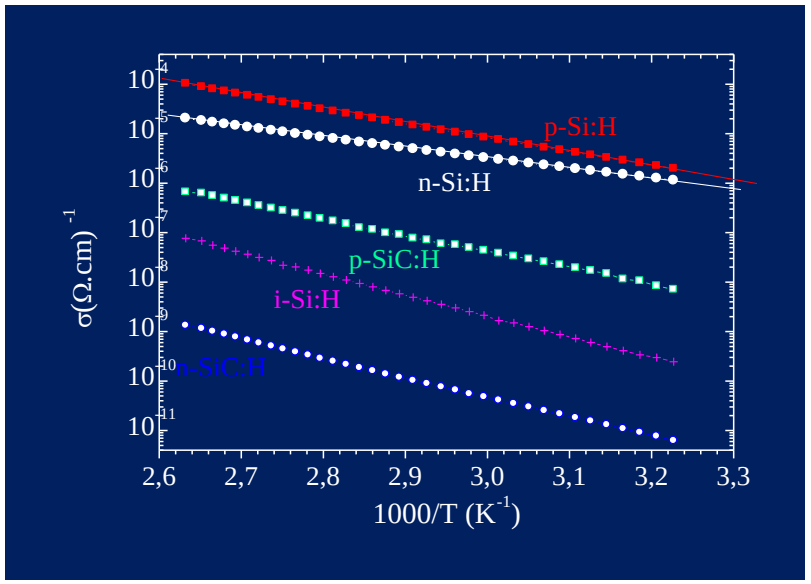
Optical characterization



- **Transmittance/reflectance**
- **Absorption coefficient**
- **Optical gap**
- **Thickness**
- **Refractive index**
- **Structural analysis**

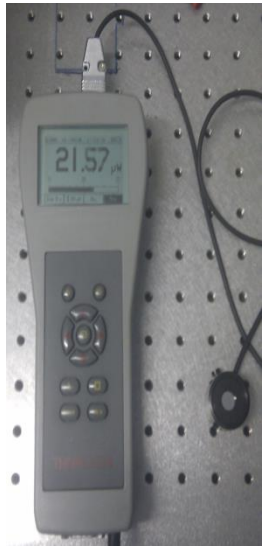


Electrical characterization (I)

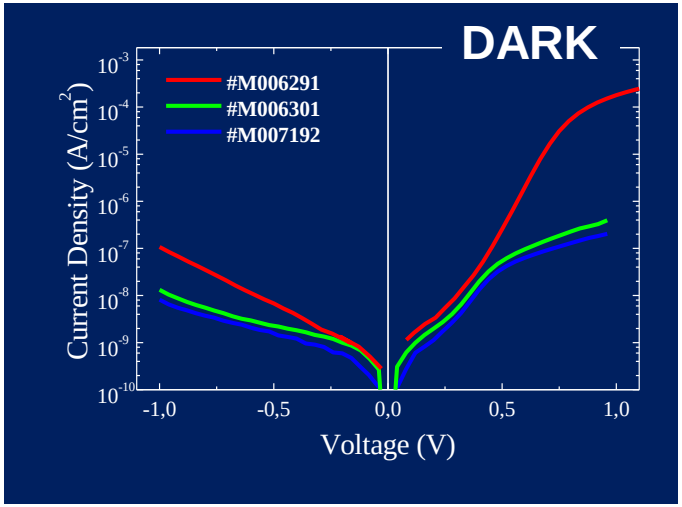


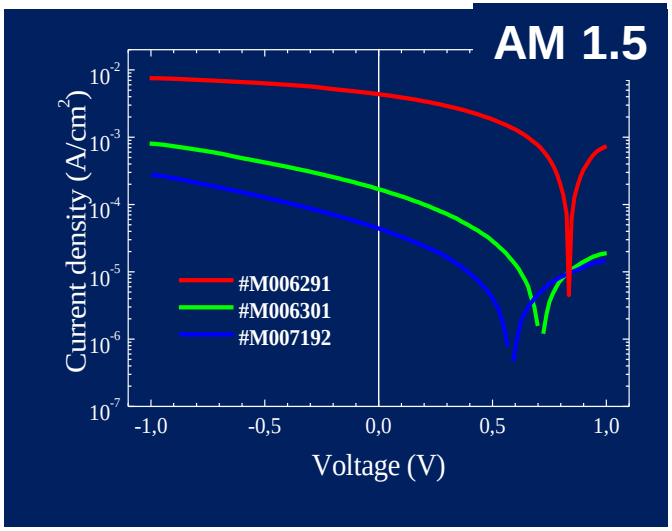
ELECTRICAL DATA

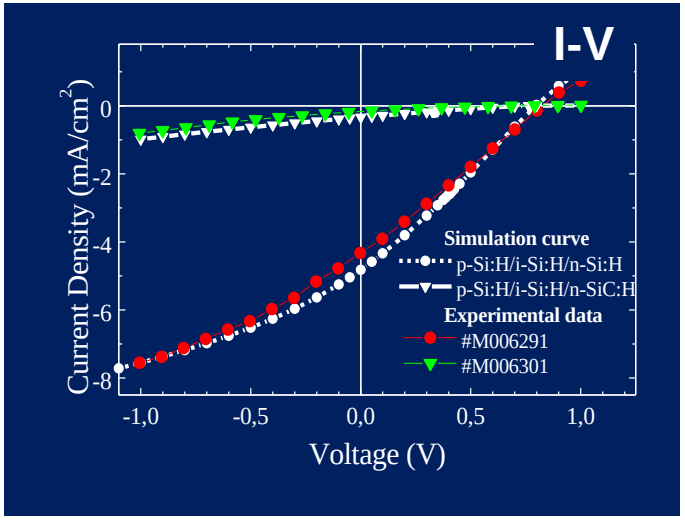
- σ (T) dependence
- σ in dark
- Activation energy
- Photoconductivity

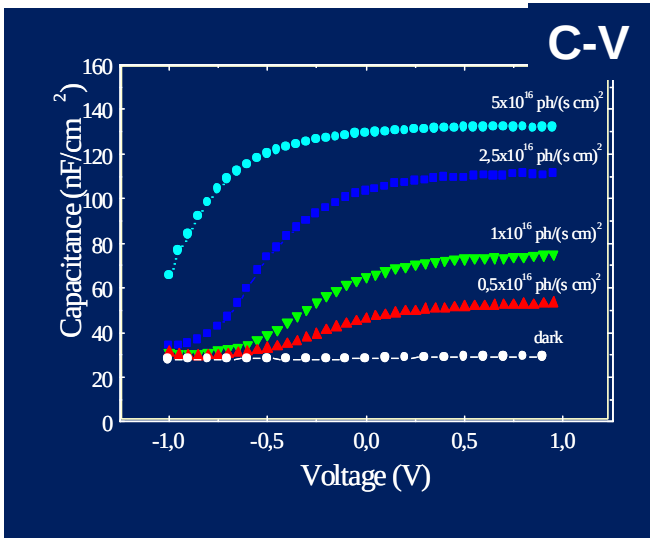


Electrical characterization (II)

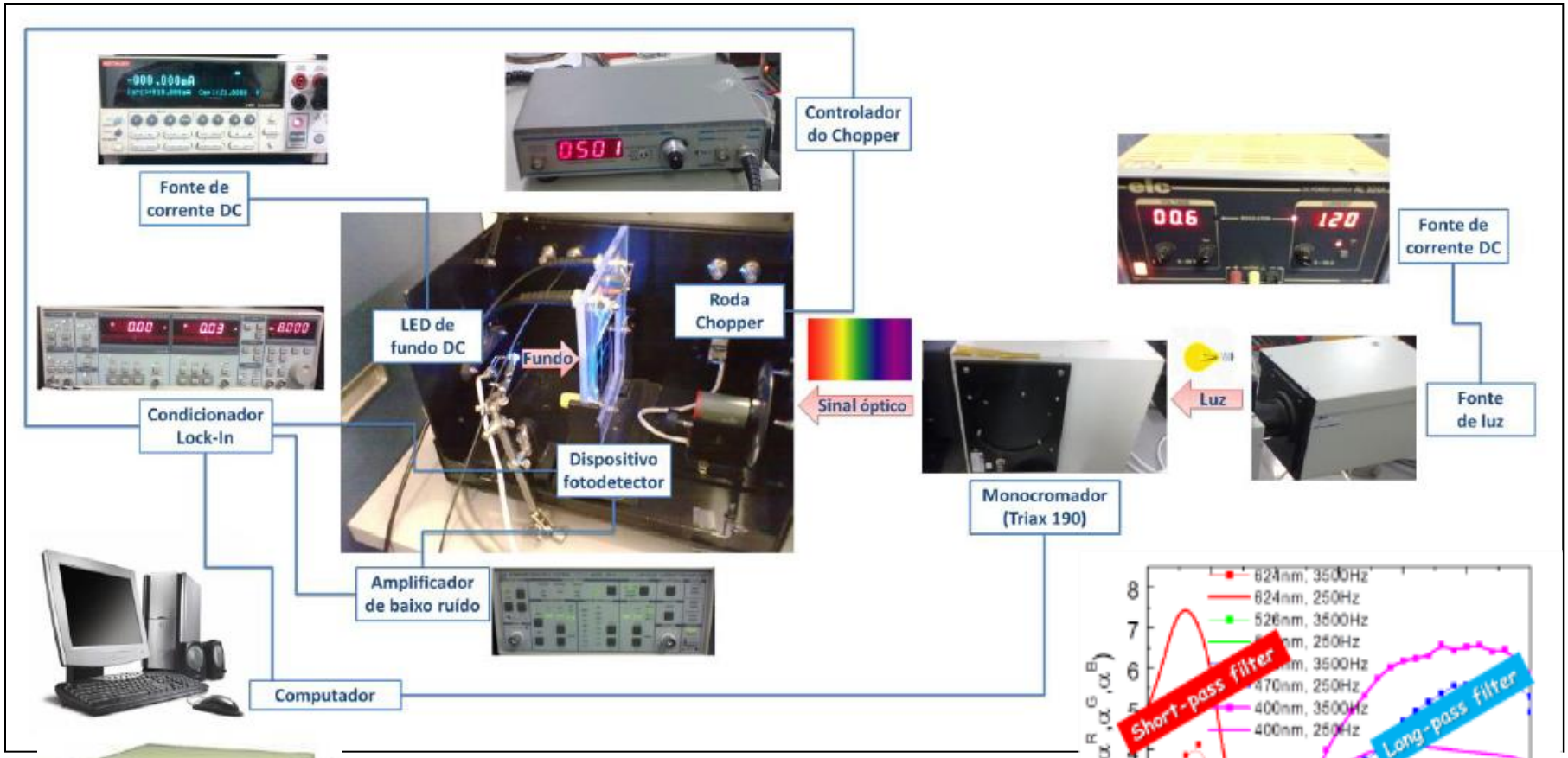


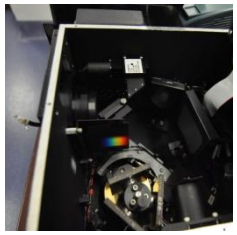


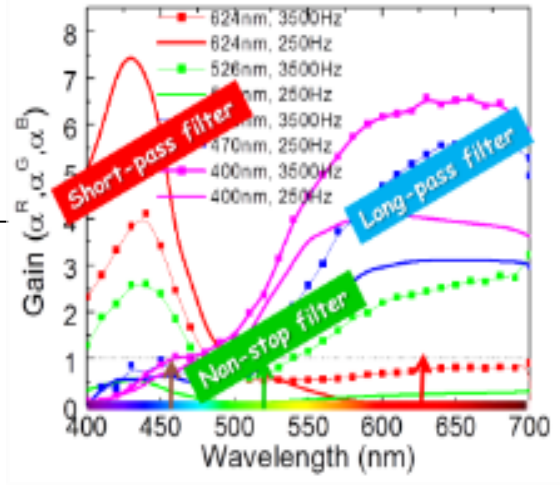




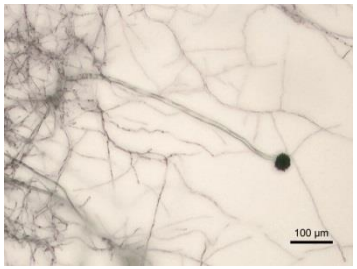
Spectral response (Triax 180, Jobin Ivon)



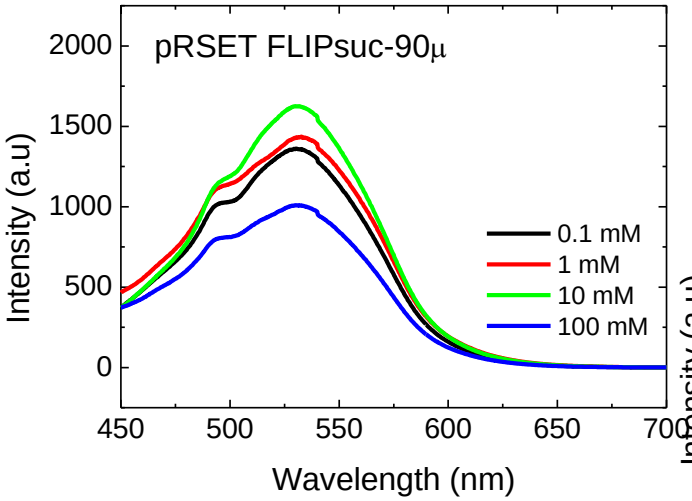


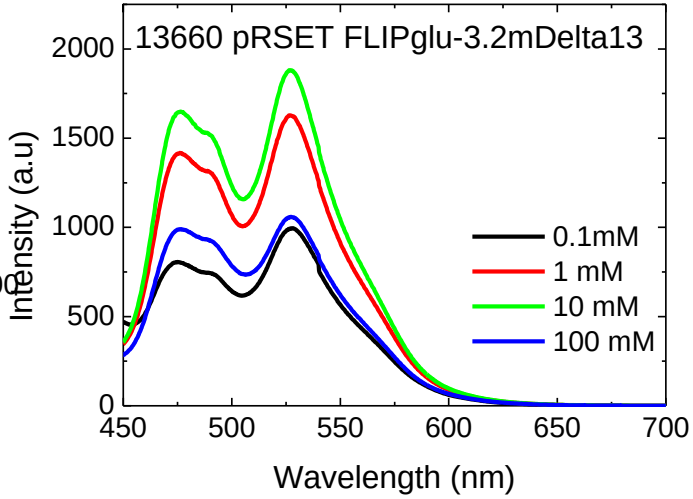


SPECTROPHOTOMETER (Jasco FP-8300)

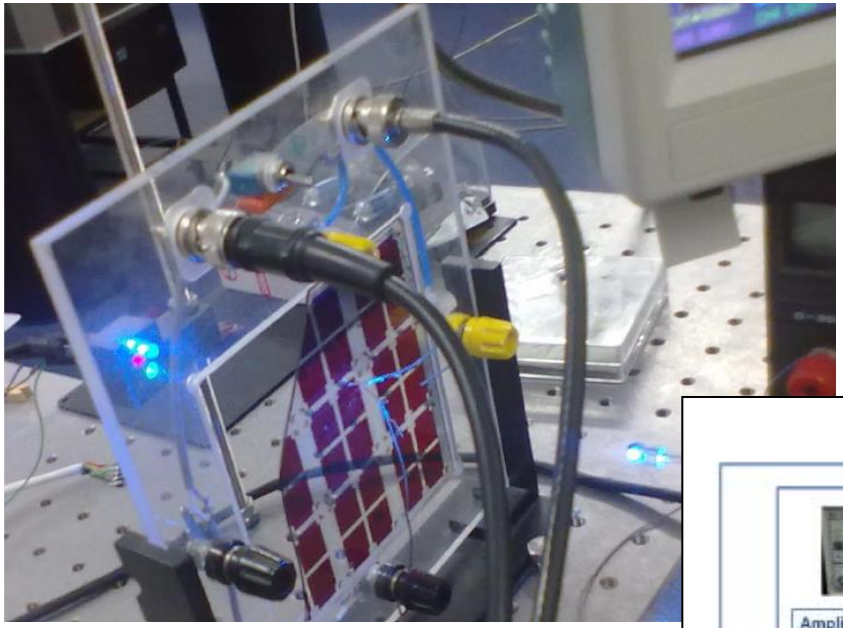


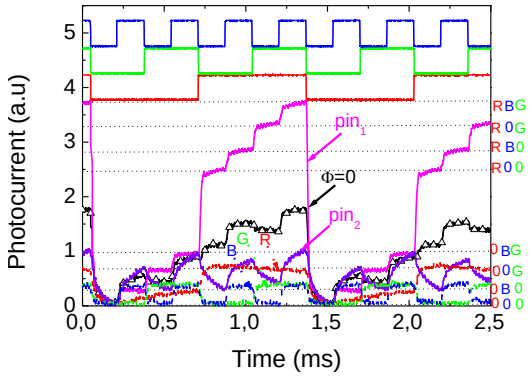
Microscopic image (100-fold magnification) of ''*Aspergillus niger*'', grown on Sabouraud agar medium.

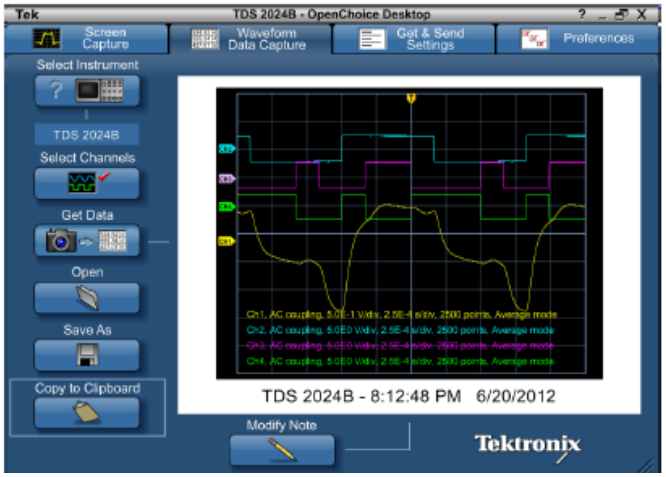


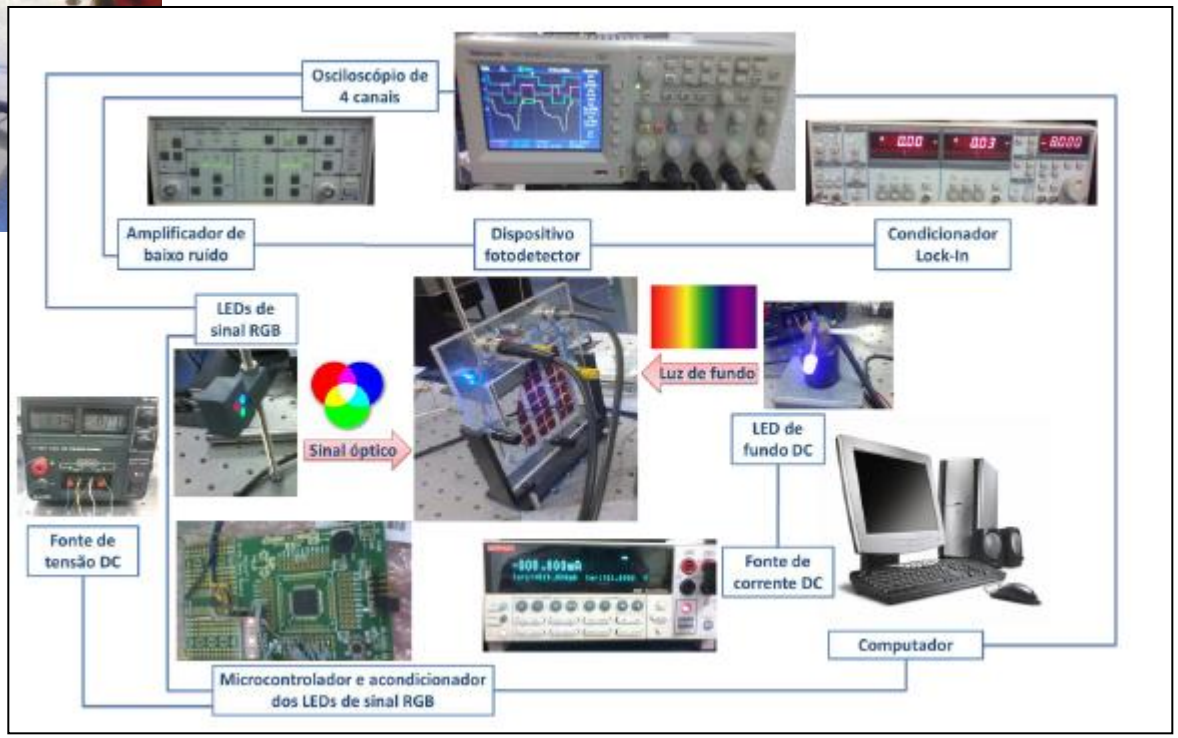


Signal analysis

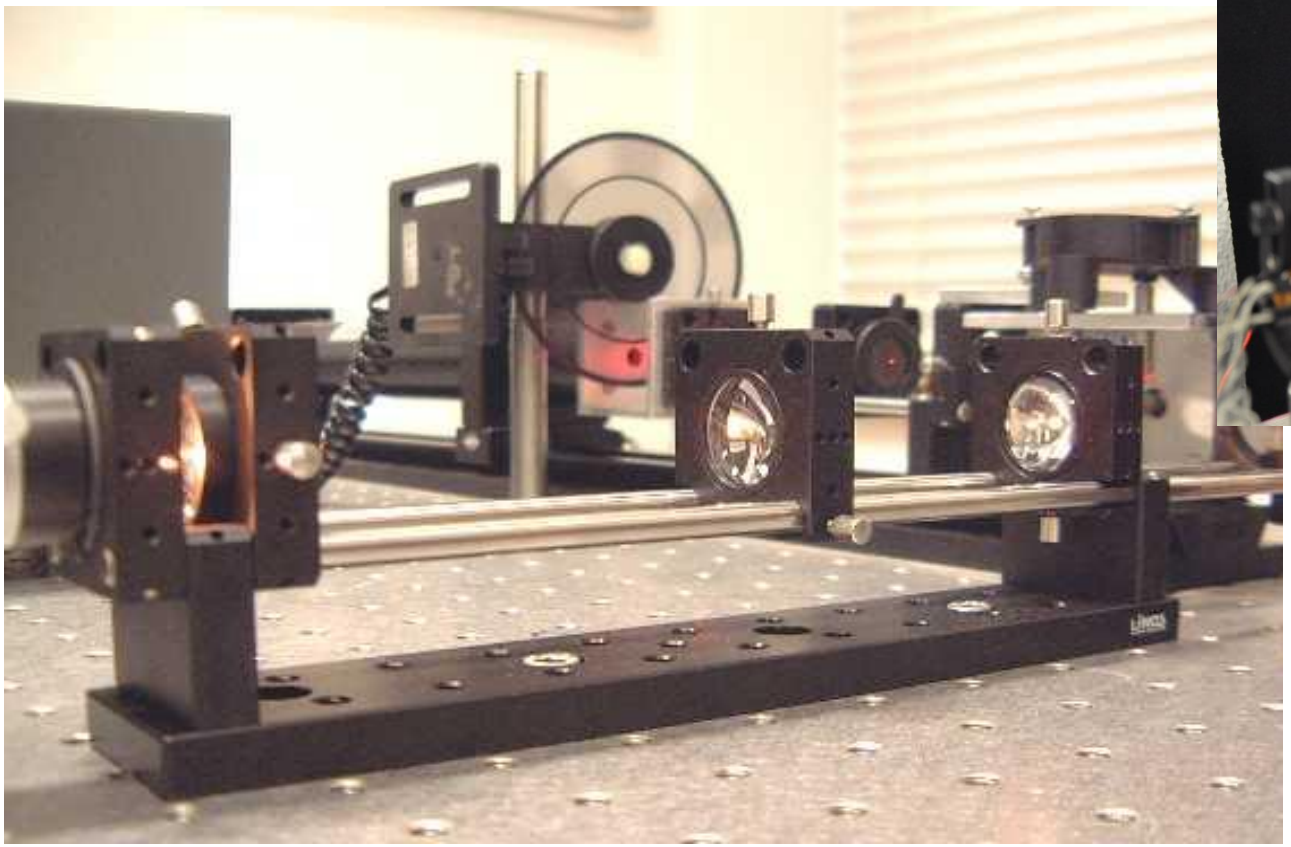


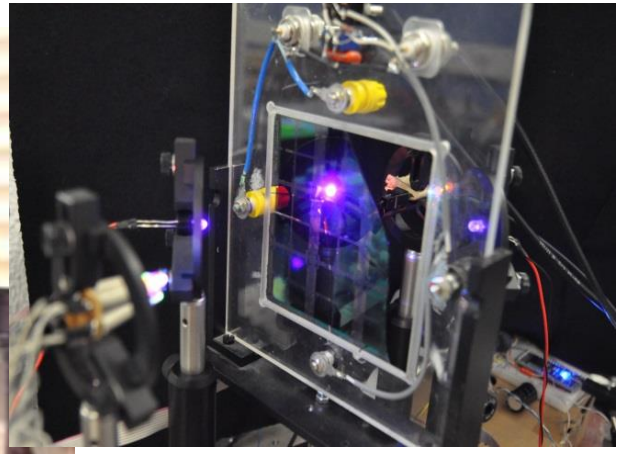






Optical bench, Thorlabs





Optical components