

## Applied Physics

The main objective of the Applied Physics Section of the Department of Physics is to prepare students for academic and industrial careers at the forefront of science and technology. Teaching and research are focused on fundamental issues in condensed matter, plasma physics and materials science and on the practical application of these concepts and techniques to technology. Moreover, due to the interdisciplinary character of this branch of science, the students (undergraduate and graduate) are exposed to collaborations with chemists, materials scientists, and chemical and electrical engineers. The balance between fundamental science and application makes the program attractive for students aiming at careers in modern technology.

The section puts emphasis on the education and training of undergraduate and graduate students since it is recognized that applied physics provides good prospects for employment as well as for research in many areas of modern technology. The faculty of the section contributed significantly in organizing and operating the Graduate Course in Photonics and Nonoelectronics leading to M.Sc. and Ph.D. degrees.

The research activities of the faculty members of the section are in the areas of microelectronic-optoelectronic and photonic materials and devices, plasma physics, and polymer science and engineering.

### I. Microelectronics

The Microelectronics Research Group (MRG) is a joint research effort of the Department of Physics and of the Institute of Electronic Structure and Laser (IESL) of the Foundation for Research and Technology - Hellas (FORTH). The group facilities are located in the Physics Department building of the University of Crete, while its multi-million euro infrastructure was mainly provided by FORTH. Moreover, the group is staffed jointly by University of Crete faculty members and IESL/FORTH researchers.

The main objectives of the MRG's research are:

- (i) the development of innovative semiconductor nanostructure/heterostructure materials, devices, and circuits, for high frequency electronics and optoelectronics.
- (ii) the accumulation of know-how and training of highly-skilled scientific personnel to support industrial activities in Europe and Greece.

MRG came into being in 1986 with the establishment of a laboratory for the growth of III-V compound semiconductors (arsenides) by Molecular Beam Epitaxy (MBE). Since then it has expanded to MBE growth of wide-bandgap semiconductors (SiC and III-nitrides), to advanced materials characterization, as well as to the design, processing and characterization of semiconductor devices and integrated circuits. It has thus become a complete, diverse, and dynamic compound semiconductor microelectronics group.

Recent and current research efforts of MRG are within the following areas:

- (i) GaAs optoelectronics (MBE, III-V/Si integration, tunable laser diodes).
- (ii) GaN and related materials and devices (MBE, HFETs, InAlGaN QW heterostructures - lasers).
- (iii) SiC microelectronics (Zener and IMPATT diodes, MBE).
- (iv) GaAs microwaves (MBE, sensors, RF MEMS, MMICs).
- (v) Nanostructures (MBE growth and physics of quantum dots).

To exploit its accumulated expertise, the group has recently launched a microelectronics services activity providing epitaxial wafers, processing and measurements. The latter two are ISO 9001 certified.

## II. Transparent Conductive Materials Group

The Transparent Conductive Materials (TCM) Group (<http://tcm.iesl.forth.gr> <sup>[1]</sup>) has an accumulated experience of more than 25 years in composing new materials (powders, films) while using a wide range of characterization techniques. Particularly the TCM group is working on the development and synthesis of new Metal Oxides Nanomaterials (for Sensing, Optical, Optoelectronics, Electronic, Photochromic and Photo-Catalytic applications) for:

- Development of a new type of metal oxide Gas Sensors for environmental mainly monitoring indoor air quality (iAQ). Study the gas sensing properties of different materials
  - Reducing Gas Molecules (e.g. CO, H<sub>2</sub>, CH<sub>4</sub>, ethanol, propane)
  - Oxidising Gas Molecules (e.g. NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub>, Cl<sub>2</sub>)
- Synthesis of Innovative Photo-Catalysts for air (indoor/outdoor) and water depollution as well as bacteria disinfection which can effectively be activated under UV and particularly visible light.
- Development of n- and p-type Metal Oxides of TCOs and ASOs
- Transparent Thin Films Transistors (TTFTs) for transparent Electronics
- Flexible Electronics on PET, PEN substrate
- Development of Electrochromic/Thermochromic materials and devices
- Hydrophilic / Hydrophobic self - cleaning surfaces for House – hold applications

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### Links

[1] <http://tcm.iesl.forth.gr>