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MICRO/NANOTECHNOLOGIES AND THE IMPORTANCE OF INFRASTRUCTURE

Specialists in the field of micro/nanotechnologies, Dr Radu Popa and Dr Mircea Dragoman explain how the current CENASIC project will significantly develop research and development infrastructure

CENASIC is a centre integrated into the National Institute for Research and Development in Microtechnologies, Bucharest, who aim to increase economic competitiveness through research, technological development and innovation.

The central mission of the CENASIC Centre is to become a national and European excellence centre in the area of applied research in integrated micro/nanotechnologies using carbon-based materials.

The main attributes of the centre will include a clear-cut thematic for research, development and collaborations focussed on applications, highly experienced researchers and technology experts, state-of-the-art R&D equipment and laboratories designed to ensure a complete technological flux in optimal integration within the existing infrastructure.

These will all offer the premises for optimal collaborations with the Romanian industry and for the stimulation of demand for innovative, scientific and technological training.

The thematic applications of the project, the new infrastructure and facilities, the integration of the existing IMT infrastructure, the measuring of economic and social impact, the dissemination of information and the advertising of the project have been formulated to optimally contribute to the development of the high-tech industry.

This is to be done at the competitive level expected in the 21st century and will take place in the Bucharest-Ilfov area and other Romanian regions that have a strategic economic role.

Project specifics

The general objective of the CENASIC project is the amplification and widening of RDI activities in IMT-Bucharest through a new focus in the sphere of micro/nanotechnologies for integrated systems. Indeed, the project places a clear accent on the objective of increasing the quality and competitiveness of national research.

To achieve this general objective, the CENASIC project has a set of specific goals which must be met. For instance, we will utilise carbon-based nanomaterials with special properties in the development of integrated products with high added value, and develop the RDI infrastructure in Romania and the EU.

Other goals include the valorisation of human potential; co-operation with foreign scientists and the stimulation of reintegration of scientists from the Romanian Diaspora; stirring the interest of students and young PhD students and researchers from the private sector towards involvement in technological research through specialisation offers; creating the premises for IMT-Bucharest and its partners to participate in complex projects, especially in the European context (FP7, Horizon 2020, bilateral partnerships, and other platforms); increasing the industrial transfer of Research, Development and Innovation (RDI) activity results by collaborating with regional industrial partners (Bucharest-Ilfov), as well as with national and international partners; and maintaining and consolidating the role of European interdisciplinary research in the field of integrated micro/nanotechnologies.

The huge innovative potential offered by convergent (or integrated) micro-nano-info technologies is recognised worldwide. In Europe, this is fully acknowledged by the priorities of the FP7 programme and the Strategic Research Agenda of the European Technological Platform, ETP.

The thematic outline (the proposed research direction) and the compositional structure (the proposed infrastructure to achieve the planned objectives) of the CENASIC project are based on the comprehensive analyses of recent accents and on prospective market evaluations pertaining to research directed toward high-added-value applications.

Dedication

CENASIC will be dedicated to technologies based on carbon nanomaterials: Silicon Carbide (SiC), graphene, nanocrystalline diamond. In order to attain these scientific targets, CENASIC will develop dedicated technological facilities – including a 200m² clean room (adjacent and complementary to the CVD+dry-etching clean room), and, advanced equipment for synthesis, processing, characterisation and simulation.

We will also develop new experimental laboratories, including four new laboratories in the clean room and an additional four elsewhere. The construction of new spaces for research and development, education and collaborations will also be undertaken, and will include a new building of over 1,000m² on an existing constructed footprint which will include five levels: a clean room; a technical level; and three levels for laboratories and offices.

A lab with a view

Inside this building (see fig. 1), CENASIC will develop several laboratories, including space for the exploration of thermal processes and chemical vapour deposition (CVD):

- There will be a laboratory for the processing of carbon-based nanomaterials and nanostructures, which represents a technological and characterisation area (for processes control),

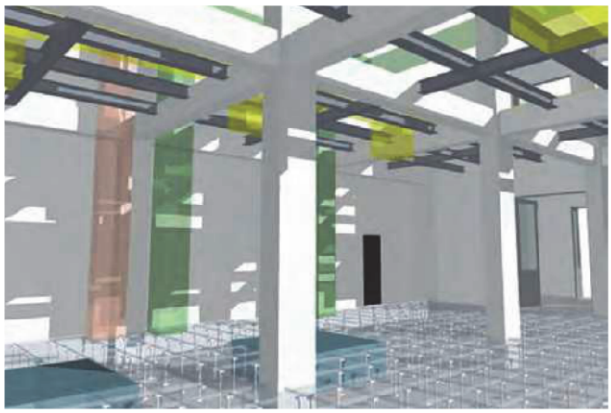

Fig 1. The future CENASIC clean room

located in the clean room and dedicated to research and development processes, innovative technologies and services;

- These services include the synthesis and deposition of nanomaterials, thin-film deposition (oxides, metals, semiconductors) and the dry processing and patterning of nanomaterials and micro-nanostructures;
- CENASIC will also purchase an ultrahigh vacuum deposition system with integrated characterisation equipped for in-situ control of substrate temperature using a pyrometer, and for controlling the growing parameters and crystallinity of the surface using RHEED (reflection high-energy electron diffraction) technology;
- We will have ultra-controlled depositions of compounds with special properties which will be performed together with advanced validation of the process' quality by evaluations and quantitative analyses of the obtained compounds;
- We also propose to create a laboratory solely for graphene technologies, which represents a technological area in the clean room dedicated to the development of nanomaterials (graphene and graphene-polymer composites) and the development of technologies for their use on standard and unconventional substrates;
- This will also be used for the development of processing and patterning procedures, the testing of new methods for obtaining graphene-based nanomaterials elaborated within CENASIC and the development and integration of new materials in microsensors and microactuators manufacturing;
- A vertical furnace will be purchased for this laboratory that will be used for thermal processes at high temperatures allowing the development of quality thin oxides (a few nanometres in range) at high temperatures on SiC, the development of thin layers of nanocrystalline diamond by extraction of silicon from SiC and the thermal treatment of nanocrystalline diamond and silicon carbide;
- A laboratory for thin-layer spectrometry will also be developed, which will represent an area in the clean room devoted to the characterisation of optical and structural properties of thin and multi-layers of organic, inorganic, composite and micro-nanostructured materials (e.g. meta-materials) and the characterisation of optoelectronic and microphotonic components of optical sensors;
- The major equipment to be acquired for this laboratory is an FTIR spectrometer used for the advanced validation of process quality through spectroscopic evaluations on a wide frequency range. The main characteristics of this include: spectral domain; THz UV VIS NIR IR; a resolution of 0.2 cm-1, optional 0.07 cm-1; an ATR module with 25 reflexions; and a photoluminescence external module. The device can also be upgraded with various external modules, for example, with Raman microscopy or polarimetry;
- A laboratory for the chemistry of hybrid interfaces will represent an adjacent support area also to be located in the clean room, which will be devoted to processes for the cleaning and functionalisation of organic and inorganic surfaces;
- An electro-mechanical and sample preparation room will represent an adjacent support area located on the same floor as the clean room, and will be dedicated to the support of those services and activities in CENASIC that require the development of electrical circuits, electronic modules, measurement boards, adapters and fastening systems;
- A laboratory for electromechanical testing and reliability will be dedicated to the development of methodologies for use in electrical measurement and characterisation for applicative research related to obtaining new materials, the implementation of new technological processes and the manufacturing of advanced devices by micro-nanostructure integration;
- The final laboratory will be used for the simulation and design of carbon-based MEMS/NEMS, and will be devoted to the development of CAD techniques for the design, development and optimisation of MEMS/NEMS (from the performance point of view) starting at the project phase.

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CENASIC
RESEARCH CENTER FOR INTEGRATED SYSTEMS NANOTECHNOLOGIES AND CARBON BASED NANOMATERIALS

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