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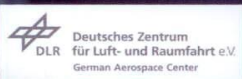
Science & Technology



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PAN EUROPEAN NETWORKS EXPLORES THE STANCE TAKEN BY ROMANIAN SCIENCE MINISTER, DANIEL FUNERIU, AND THE OBJECTIVES OF THE NANOPROSPECT PROJECT IN ORDER TO INVESTIGATE THE STATE OF THE COUNTRY'S SCIENTIFIC R&D

The development of Romanian science

Romanian science is improving rapidly, and while universities and other research institutes may still be seen as underperforming, the result of years of underinvestment, a significant amount of extra funding has been awarded to the scientific and R&D communities since 2005 in the hope that it will act as a catalyst for excellence. With the appointment of Daniel Funeriu as the Romanian science minister in 2009, and the formation of new research bodies that are to explore some of the more exciting emerging technologies, the future of science in Romania looks promising.

Speaking to nature.com earlier this year about the perceived underperformance of Romanian scientific institutions, Funeriu outlined the problems he wants to eradicate: "The money did not necessarily get distributed to the best people, and academic positions don't necessarily go to the best people either."

"Scientific nepotism still exists. We need more input from Romanian scientists abroad and an influx of the best international practices."

As a result, the minister has introduced reforms into the country's management of scientific research, much of which has focussed on the redirection of funding and resources. "I know how science needs to be managed," Funeriu, who has a PhD in chemistry, said.

"I know the nuts and bolts of a scientific career and how to recognise the best research, worthy of funding from public resources. I am also a big fan of private research. People who were used to getting money, even though their results were humdrum, are angry. They know they can't convince me that what they are doing is important if it isn't."

NANOPROSPECT

Funeriu's hard-line approach to scientific research, education and funding certainly seems to be the right one, and the development of the NANOPROSPECT initiative is a prime example of how the Romanian government has identified and supported key emerging technologies.

NANOPROSPECT is a 'prospective study' devoted to nanotechnology, with the main objective of analysing the Romanian potential for applications and for international co-operation, while also positing a national strategy for nanotechnology, in line with the EU strategy.

Professor Dan Dascalu, CEO and president of the board of the National Institute for Research and Development in Microtechnologies (IMT-Bucharest) and full member of the Romanian Academy, informed the JRC-Romania Information Exchange Event in Bucharest this year that NANOPROSPECT will also "suggest measures to accelerate innovation, the industrialisation of results in R&D, the full use of experimental facilities and the formation of interdisciplinary competencies."

Dascalu highlighted the fact that while numerous projects and important acquisitions for performing equipment have received funding in Romania, a plan "that would concentrate the research for specific domains in which there is a critical mass and an interest from economy and society" and a "strategy that would cover all the important aspects for the development of nanotechnologies at national level," were lacking.

He also explained that "R&D interaction with industry in nanotechnologies becomes really attractive through the interest shown by large companies, and also through creating clusters of companies that are interested in the applications for a certain domain."

NANOPROSPECT has selected nanoelectronics and photonics, bio-nanosystems (including nanomedicine, pharmaceuticals and the application of magnetic materials), energy, nanomaterials (applications) and the evaluation and management of risk as research priorities.

There are several new thematic areas which are expected to impact on nanoelectronics, Dascalu said, which include carbon nanotubes-based nanoelectronic circuits, improved communications or environment monitoring, nanomagnets and nanowires.

In conclusion to an informative presentation that encompassed everything from the design of an RF NEMS switch based on carbon nanotubes, to hybrid inorganic-organic nanomaterials and the innovations being made through the CENASIC project, Dascalu called for a "reinforcement of the experimental infrastructure in various R&D organisations and an increasing interaction with industry."

Science in Romania thus seems to be developing at a significant rate, not least in the varied fields of nanotechnology and future and emerging technologies, more generally.

Indeed, while there are bound to be recommendations that need to be made – such as those underlined by Dascalu – and while some members of the scientific community may not support Funeriu's re-allocation of funding or the education law (which means a post-PhD qualification is required to become a professor and supervise PhD students), the country's present and future scientists can rest assured that investment and innovation run in tandem, and that the marrying of science and politics in Romania will continue to nurture an environment in which both can thrive.

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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-Ifov 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-Ifov), 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),

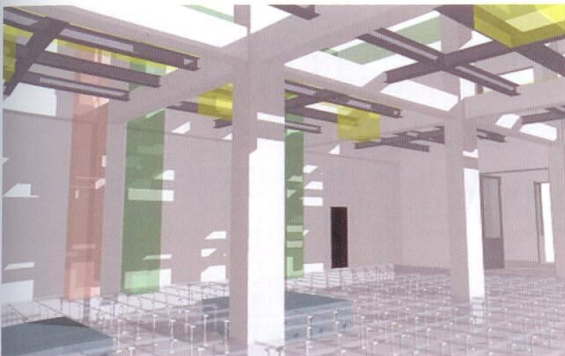


Fig 1. The future CENASIC clean room

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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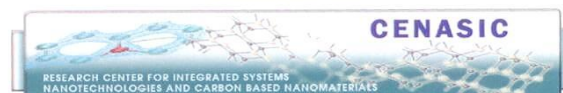


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Research Centre for Integrated Systems Nanotechnologies and Carbon Based Nanomaterials – CENASIC (www.imt.ro/CENASIC)

Dr Radu Popa
Senior Researcher
radu.popa@imt.ro

Mircea Dragoman
Senior Researcher
mircea.dragoman@imt.ro

tel: +40 212 690779 or +40 212 690774
www.imt.ro