

2. Description

The new infrastructure will allow the consolidation of some research domains which are relatively new inside INCDFM, like physical phenomena in the soft-matter, understanding by this the biologic and biocompatible materials, or surface and interface physics in low dimensional structures, going down to quantum dots.

The equipments to be purchased in the frame of the project are designated, in the most part, to the preparation and characterization of multifunctional materials under nanostructure form. Therefore, 2 absolutely new facilities will be generated inside INCDFM, namely:

1. **Laboratory for advanced characterization by transmission electron microscopy (TEM).** This will be, practically, a new laboratory despite the fact that the old TEM JEOL will be still in use. The purchasing of a new microscope is envisaged, with facilities for high resolution (HR-TEM) studies, including the new technology for correcting the spherical aberrations of the magnetic lenses (C_s technology), which will allow the achievement of a spatial lateral resolution better than 1 Angstrom and of an energetic resolution better than 0,1 eV. The new microscope will have EDX and EELS facilities. A dual-beam equipment, including FIB and SEM, will be also purchased. The system will allow the realization of nanostructures and preparation of the sample for TEM.
2. **The Clean Room.** A clean space of class 100-1000 will be created for lithography facilities with electron beam, photo-lithography, nanoidentation. Nanostructures and metal electrodes of various geometries will be possible to be designed and processed with a resolution better than 1 micron, on semiconductor and/or oxide multifunctional materials. Some facilities for incipient morphologic characterization, such as equipment for thickness measurements of thin films, SEM, AFM, will be also included.

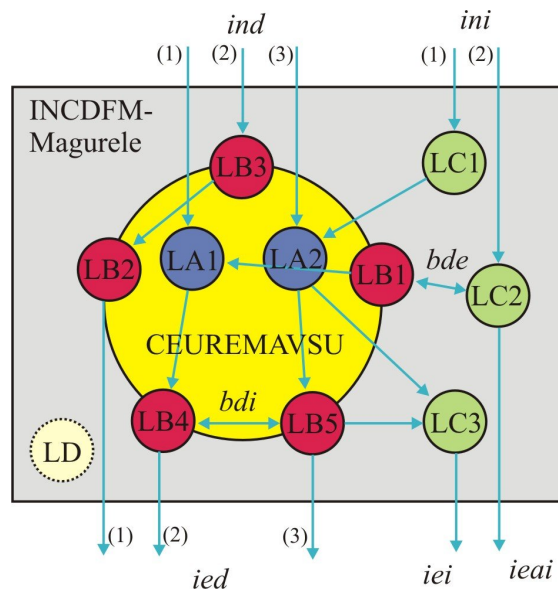
Besides the 2 new laboratories, a number of other 5 laboratories will be modernized, namely:

1. **B1. Laboratory for surface and interface science.** An equipment for deposition with molecular beam (MBE) is already contracted and in course of purchasing. A high pressure XPS will be also purchased from other funds. To complete the laboratory, the following equipment will be bought in the frame of the present project: angle and spin resolved photoemission spectrometer, with band mapping possibility; a high resolution EELS spectrometer; equipment for low energy electrons microscopy (LEEM); equipment for photoelectron microscopy (PEEM).
2. **B2. Laboratory for complex characterization of materials from the point of view of structure.** In completion of the recently acquired equipments, including 2 new X-ray diffractometers (XRD) and SEM, it is intended to purchase a new SPM, a pulsed RES spectrometer and a state-of-the-art Mossbauer spectrometer (the last two equipped with facilities for measurements at different temperatures).
3. **B3. Laboratory for studies in the high frequency domain (THz).** The equipment which will be purchased will cover the frequency range higher than 0,1 THz, allowing the approaching of the THz spectroscopy. For the domain below 0,1 THz the characterization equipment is either already existing or it is in course of purchasing from other funds.
4. **B4. Laboratory of Optics and Spectroscopy.** At present the laboratory is possessing a variety of new equipments such as: i) a FT Raman spectrophotometer equipped with a YAG-Nd laser, allowing Raman studies at an excitation wavelength of 1064 nm; ii) a fluorescence spectrometer, iii) three absorption spectrometers for the UV-VIS, UV-VIS-NIR and FTIR domains; iv) a fluorescence microscope, v) scanning electron microscope with energy dispersive X-ray analysis and cathodoluminescence accessories and vi) a new spectro-ellipsometer for the UV-VIS-NIR domain. To complete the laboratory it is intended to purchase a new Raman spectrophotometer allowing the use of several excitation wavelengths

in the VIS domain, and of a near field optical microscope. These two new equipments will allow: (i) a complete characterization of the vibration spectrum of the analyzed materials, on a wide spectral range of excitation; (ii) the use as detection systems of some non-linear optical processes; (iii) the enhancement of the spatial resolution down to a few tens of nm.

5. **B5. Laboratory of complex electric and magnetic characterization.** This laboratory is already possessing some facilities allowing to perform various types of measurements in electric and magnetic fields, at different temperatures and in different conditions of illuminations. However, the facilities allowing the simultaneous applications of electric and magnetic fields are missing. For this purpose it is intended to purchase a PPMS system, allowing perform some complex magnetotransport, conductivity and thermal transport measurements. A MPMS equipment including a SQUID detector will be also purchased, allowing a sensitivity for magnetization measurements better than 10^{-8} emu in a time better than 4 seconds. The two systems are functioning with predesigned contact geometries. For measurements on samples with variable geometries and sizes of contacts it is intended to purchase a cryprober with micromanipulator arms, optical window and magnetic field, allowing measurements on a large temperature domain (4,2-475K), with simultaneous application of electric field, magnetic field and light on contacts with size of a few microns. Finally, for a better characterization of ferroelectric thin films and multilayers a special tester for ferroelectric materials will be purchased, which is working up to a frequency of 1 MHz.

The relation between the new Centre (abbreviated as CEUREMAVSU) and INCDFM is illustrated by the following Figure:



This diagram describes the manner of working in INCDFM in the presence of the CEUREMAVSU Centrum. The CEUREMAVSU Centrum consists in the following:

- New or type “A” laboratories (abbreviated as LA1, LA2,). These laboratories will be fully financed by the present Project.
- Almost new laboratories, meaning that their financing is already approved (via the “Capacities” Program or via the Institutional Investment Program) and in some cases their endowment had began foreseeing installations of last generation; for these laboratories, however, in order to achieve the desired performance, financing is required also from the present Project (“modernized laboratories” or “B” type: LB1, LB2,...). These laboratories will be part of the CEUREMAVSU Centre as well.

Among these two types of laboratories, INCDFM have its own laboratories and facilities, outside of the CEUREMAVSU Centrum (laboratories type “C”: LC1, LC2,...). These laboratories are already well equipped for achieving the desired level of excellence in INCDFM and no further funds are

requested from this project. They will be, however, used during the syntheses, characterizations and information exchange flows with the CEUREMAVSU laboratories.

Finally, it is reasonable to presume that some INCDFM- laboratories having no relation with the CEUREMAVSU Centrum may exist (laboratories type “D”). At the level of institutional management, efforts for strengthening the inter-relations between all the laboratories will be made aiming to frame all the laboratories to the type A, B or C; in the same time, the possibility for encouraging of new research directions, totally different from “advanced materials, surfaces and interfaces”, cannot be excluded (see the recently formed group called “Econo-physics”).

The arrows from the diagram show the flows of information (“studies”) and mater (samples, materials, devices) inside INCDFM, in relation with CEUREMAVSU, inside CEUREMAVSU as well as between INCDFM and outside the institution.

With respect to the CEUREMAVSU laboratories, the flows-in (information and matter) can be classified as follows:

- Direct flow-in *ind*: the access from outside to a CEUREMAVSU laboratory is direct
- Indirect flow-in *ini*: the access from outside to a CEUREMAVSU laboratory is via a “C” type laboratory from INCDFM (outside CEUREMAVSU); the information or matter is initially processed in this laboratory and then distributed to CEUREMAVSU.

Similarly, the flows-out (information, materials, technologies, know-how, publications, patents) can be realized directly by the CEUREMAVSU laboratories (*ied*) or indirectly, via a “C” type laboratory (*iei*) that additionally processes the information or materials from a CEUREMAVSU laboratory. As examples for the *iei* case, CEUREMAVSU has a technological solution and one of the type “C” laboratories implements it; or CEUREMAVSU performs experimental studies which stimulate proposals for theoretical models which are developed by a “C” type laboratory.

The relations inside INCDFM involving CEUREMAVSU laboratories can be uni- and bidirectional inside CEUREMAVSU (*bdi*) or with the implication of an external laboratory of type “C” (*bde*). A situation which can also appear and it is shown in the above figure is that when a type “C” laboratory (see LC2 in the figure) benefits of both, a flow-in and a flow-out, apparently with no interaction (transfer of information or matter) with CEUREMAVSU. This flow-out, apparently independent (*ieai*), includes in fact the relation with CEUREMAVSU because at a certain moment LC2 had an bidirectional interaction with LB1- part of the CEUREMAVSU Centrum.

Obviously, this net of cooperation channels (blue arrows) will be very dynamic and could change, actually, from hour to hour. It is foreseen to make a “live” actualization on the INCDFM-web page, of the working and cooperation progress, including explicitly both the transfers (substances, information) as well as the status of each laboratory (performed tasks, personnel). The history of the flows-in and –out and of the performed operations could be also accessed.

At national level, similar institutions with concerns in advanced fields of the science and technology relevant for the thematic area 5 are: National Institute for Micro-technologies (preoccupations in the field of micro- and nano-technologies), National Institute for Electrical Engineering ICPE CA Bucuresti (preoccupations in the field of magnetism, materials for electro-technique), National Institute R&D for Isotopic and Molecular Technologies Cluj-Napoca (preoccupations in the field of low dimensional systems, materials with applications in biology and synthesis of isotopes), National Institute R&D for Technical Physics Iasi (preoccupations in the field of magnetism), Institute for Interdisciplinary Experimental Studies of Babes-Bolyai University Cluj-Napoca (preoccupations in the field of nano-bio-photonics). All these institutions benefit of international recognition but INCDFM is leading by far, especially with respect to ISI publications and citations. On the other hand, none of the above mentioned institutions has defined their main field of research as focusing on advanced materials, surfaces and interfaces. In the same time, we appreciate that compared with the mentioned Institutions, INCDFM can de jure pretend that, in the mentioned field, it is the regional leader in the South-East Europe. From this point of view, we consider that the CEUREMAVSU establishing project, corroborated with the reorganization of the INCDFM around this Centrum, to lead in the hierarchy of the projects financed via POS-CCE program.

Among these institutions, there are also some institutes of Romanian Academy or research centers affiliated to Universities, which also perform research activities in different fields concerning

materials as ceramics, non-ferrous materials, polymers, bio-compatible materials. INCDFM is however, the only one Romanian Institute with preoccupations which cover almost the full range of advanced materials with multi-functional properties: semiconductors, materials with superconducting, dielectric, piezoelectric, piroelectric, ferroelectric, magnetic, multiferoic properties, polymers, biocompatible materials, optical and liquid crystals. For most of the materials the entire research cycle, from preparation to developing of applications and technological transfer to beneficiaries interested in production, is covered. The project implementation together with the increase of the research infrastructure quality will allow to deepen the underlying research in the field of abovementioned materials with focus on nano-structures, nano-composites and thin and ultra-thin films.