



Facilities for RD in nanotechnology

- *NANOPROSPECT* preliminary analysis -

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Summary

- International: investments, modern priorities and trends
- National: preliminary review



International: investments in nanotechnology

- 15% increase in 2008 → USD 18 billion globally
- global 16% increase (to USD 8.4 billion) of public (government) investments

Investments in infrastructures

- **USA/2000/2007** - NNI
 - Network for RD&I: ~70 state-of-the-art centers/facilities
 - Special accent of the updated strategy: increased focus on industrial needs
 - USD 1.9 bln./2008 (vs 1.8 bln. in Asia)
 - Illustration of efficient "documented networking" for processing and characterization tools:
<http://www.nnin.org/> (Natl. Nanotech. Infrastructure Network)
- **Europe** - numerous new centers created, from large facilities (100's of researchers, multi-million euro budgets), to smaller scale facilities (specific target areas, usually around universities).
 - European financing programs - accent on networking.
 - over 300 centers/30 states.
 - ~18 centers are "major EU research infrastructures": significant clean room areas, comprehensive tool coverage, highly specialized staff (RD, technology transfer and training).
 - USD 2.2 bln./2007.
- **China; Russia** (USD 5bln.)



International: modern priorities and trends [1]

Main types

- clustering/**networking** of facilities (e.g., NNIN, EUMINAfab)
- **large, multivalent**, government-funded infrastructures
- **small, specialized** infrastructures, focused on narrow research directions

Recent accents

- special focus towards attracting highly **experienced PIs**
- promotion of a strong, instrument-driven **interdisciplinarity**, leading to scientific integration/convergence (technical neighborhoods, platforms, optimized functionality of spaces)
- optimization of **administrative and operational** activities - to cope with the increasing complexity
- special focus on **education and training** (students, young scientists, emergent private partners)
- **grouping of spaces** by function instead of by department; by functional needs (air purity, air contamination, humidity and temperature, support utilities)
- augment **efficiency of investments** through resource sharing policies ("**open centers**") and creation of complete **technological fluxes** - design/simulation/optimization, nano and mixed lithography and structuring, controlled material deposition/growth, rapid prototyping, multi-modal analysis/characterization, system integration, testing etc.
- developing "**core-labs**" for sharing of highly valuable resources among many users



International: modern priorities and trends [2]

Open facilities

- **Concept:** free (regulated) access for: internal/external research groups, young researchers, industrial partners/clients
- **Collaboration means:** *project-based*, with IP sharing; *contract-based*, through scientific and technological services
- **Main benefits:**
 - encourage **interdisciplinarity** - constructive sharing of technologies and knowledge
 - best support for **education** - human resource training
 - ensure efficient **interfaces** with private partnerships - hands-on collaborations

Networking of open facilities

- further stimulates **interdisciplinary** communication and sharing
- provides complete sets of high-quality **services for industry**
- ensures **best-option** technological resource and expertise in each experimental area
- optimization of **resource usage** - diversified/maximized capitalization on equipment capabilities
- enhances the support for human resource training
- ensures best **outcome-investment** ratio



National: initial review [1]

Preliminary objective

- single-out a simplified methodology for **indexing of national resources** for RD in nanotechnology
- main focus: mapping of national capabilities, based on **equipment/process categories**

Methodology

- identification of **categories** of tools (experimental capabilities) relevant for the indexation
- use the preliminary information provided through the NANOPROSPECT site (55 registrations: universities and research institutes)
- per-capability **rating** and general **mapping** - model: *NNIN Process Offerings* / NNIN site

(www.nnin.org/nnin_process2.html)

Categories considered

Cleanroom

(at least class 1,000)

Nanolithography

Microlithography

Physical depositions

Thermal processes

Chemical depositions
(plasma based), **MBE**

Dry etching

Beam characterization:

SEM, FE-SEM, TEM, X-ray, FIB...

SP characterization:

AFM, STM, NSOM, profilometry, surface nano-characterization...

Spectrometry:

IR, Raman, NMR, mass...

Chemical analysis and processing

Nano-bio:

spotting, characterization,
nanoparticle analysis...

Laser processing

High power computing

National: initial review [2]

Rating principles

- 0 to 4 points per equipment category, for each experimental facility reported in the database (NNIN-inspired)
 - 0 points - no significant capability
 - 1 point - limited capability
 - 2 points - good capability
 - 3 points - excellent (exceeding the capabilities available in most other registered facilities, and offering experimental support suitable for most projects)
 - 4 points - outstanding (capabilities outstanding/unique at national level, highly competitive internationally)
- Not yet rated:
 - specific operation conditions of equipment categories analyzed - air class, support utilities, usage of all installed capabilities, chemical compatibility issues
 - experience of equipment's/capability main operators
 - degree of usage for important projects



National: initial review [3]

		Camera alba (clasa cel putin 1000)	Nano- litografie	Foto- litografii	Depuner i fizice	Procese termice	Depuner i chimice (plasma) , MBE	Corodari uscate	SEM, FIB, TEM, XRD	AFM, STM, SNOM, profilo- metrie, nano- caracteriza re suprafete	Spectrome trie (IR, Raman, NMR, masa), analize/pr ocesari chimice	Nano-bio (spotting, caracterizari, analize nanoparticul e)	Procesa ri laser	High Power Comput ing
1	S.C.METAV Cercetare Dezvoltare S.A. METAV-CD	-	-	-	-	-	-	-	2	-	1	-	-	-
2	Science Biocreative - SBC S.R.L.	-	-	-	-	-	-	-	-	-	-	-	-	-
3	IC Interdisciplinare in Bio-Nano-Stiinte - ICI-BNS	-	-	-	-	-	-	-	1	2	3	3	-	-
4	INCD pentru Fizica Laserilor, Plasmei si Radiatiei - INFLPR	-	-	-	3	-	1	2	2	2	3	-	4	-
5	Univ. POLITEHNICA din Bucuresti - UPB	-	-	-	-	3	-	-	3	-	2	0	-	-
6	Inst. oncologic Ion Chiricuta - IOCN	-	-	-	-	-	-	-	-	-	-	4	-	-
7	Inst. de Biochimie al Academiei Romane - IB-AR	-	-	-	-	-	-	-	-	0	-	1	-	-
8	Inst. de Chimie Timisoara al Academiei Romane - ICT	-	-	-	-	2	-	-	-	-	2	-	-	1
9	Univ. Politehnica Bucuresti - UPB	-	-	-	-	-	-	-	-	-	1	-	-	-
10	Centrul IT pentru Stiinta si Tehnologie SRL - CITST	-	-	-	-	-	-	-	-	-	-	-	-	-
11	CHEMSPEED - CHEMSPEED	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Univ. Politehnica din Bucuresti-Grupul de cercetare pentru materiale polimerice avansate - UPB-MPA	-	-	-	-	-	-	-	1	-	3	-	-	-
13	INCD pentru Fizica Materialelor - INCDFM	4	3	0	4	2	3	0	4	4	4	3	3	0
14	SC OPTOELECTRONICA-2001 SA	-	2	0	-	-	-	-	-	-	0	-	-	-
15	Centrul International de Biodinamica - CIB	-	-	-	3	-	-	-	-	1	-	3	-	-
16	INC Aerospatie "Elie Carafoli" - INCAS	-	-	-	-	3	-	-	1	-	-	-	-	-
17	Univ. "Aurel Vlaicu" din Arad - UAV													
18	SC Plasma Jet SRL - PJ	-	-	-	-	-	2	-	-	-	-	-	-	-
19	Inst. de Biologie Bucuresti - IBB	-	-	-	-	-	-	-	3	-	3	3	-	-
20	INCD pentru Metale Neferoase si Rare - INCDMNR-IMNR	1	-	-	2	4	1	-	-	-	3	3	-	-





		Camera alba (clasa cel puțin 1000)	Nano- litografie	Foto- litografie	Depuneri fizice	Procese termice	Depuneri chimice (plasma), MBE	Corodari uscate	SEM, FIB, TEM, XRD	AFM, STM, SNOEM, profilo- metrie, nano- caracterizări suprafețe	Spectrometrie (IR, Raman, NMR, masă, analiză/procesări chimice)	Nano-bio (spotting, caracterizări, analize nanoparticule)	Procesări laser	High Power Computing
1	S.C. METAV Cercetare Dezvoltare S.A. - METAV-CD	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Science Biocreative - SBC S.R.L.	-	-	-	-	-	-	-	-	-	-	-	-	-
3	IC Interdisciplinare în Bio-Nano Științe - IC-IBS	-	-	-	-	-	-	-	-	-	-	-	-	-
4	INCD pentru Fizica Laserilor, Plasmei și Radiației - INFLEP	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Univ. POLITEHNICA din București - UPB	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Inst. oncologic Ion Chiricuta - IOCN	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Inst. de Biochimie al Academiei Române - IB-AB	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Inst. de Chimie Timisoara al Academiei Române - ICT	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Univ. Politehnica București - UPB	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Centrul IT pentru Știința și Tehnologie SRL - CITST	-	-	-	-	-	-	-	-	-	-	-	-	-
11	CHEMSPEED - CHEMSPEED	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Univ. Politehnica din București-Grupul de cercetare pentru materiale	-	-	-	-	-	-	-	-	-	-	-	-	-
13	INCD pentru Fizica Materialelor - INCDFM	-	-	-	-	-	-	-	-	-	-	-	-	-
14	SC OPTOELECTRONICA-2001 SA	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Centrul Internațional de Biodinamica - CIB	-	-	-	-	-	-	-	-	-	-	-	-	-
16	INC Aerospațiale "Ele Carafoli" - INCAS	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Univ. "Aurel Vlaicu" din Arad - UAV	-	-	-	-	-	-	-	-	-	-	-	-	-
18	SC Plasma Jet SRL - PJ	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Inst. de Biologie București - IBB	-	-	-	-	-	-	-	-	-	-	-	-	-
20	INCD pentru Metale Neferoase și Rare - INCDMNB-ASNE	-	-	-	-	-	-	-	-	-	-	-	-	-
21	IIINCD pentru Fizică și Inginerie Nucleară-Horia Hulubei-IFIN-HH - IFIN-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	INCD pentru Optoelectronică INOE 2000 - INOE 2000	-	-	-	-	-	-	-	-	-	-	-	-	-
23	INCD pentru mașini și instalații destinate agriculturii și industriei	-	-	-	-	-	-	-	-	-	-	-	-	-
24	INCD pentru științe biologice București - INCDSB	-	-	-	-	-	-	-	-	-	-	-	-	-
25	INCD pentru Textile și Pielarie - INCDTP	-	-	-	-	-	-	-	-	-	-	-	-	-
26	INCD pentru Mecatronica și Tehnica Măsurării - INCDMTM	-	-	-	-	-	-	-	-	-	-	-	-	-
27	INCD chimico-farmaceutică - ICCF București - INCDCF-ACCF	-	-	-	-	-	-	-	-	-	-	-	-	-
28	Univ. de Medicină și Farmacie - UMFCO	-	-	-	-	-	-	-	-	-	-	-	-	-
29	INCD pentru Electrochimie și Materie Condensată Timisoara - INCEMC	-	-	-	-	-	-	-	-	-	-	-	-	-
30	S.C. Centrul de Cercetare Pentru Materiale Macromoleculare SI	-	-	-	-	-	-	-	-	-	-	-	-	-
31	Univ. Dumarea de Jos Galați - Centrul de Nanostructuri și Materiale Funcționale -	-	-	-	-	-	-	-	-	-	-	-	-	-
32	INCD pentru Microtehnologie - IMT-București	-	-	-	-	-	-	-	-	-	-	-	-	-
33	Univ. de Științe Agricole și Medicină Veterinară Cluj Napoca - USAMVCH	-	-	-	-	-	-	-	-	-	-	-	-	-
34	INCD pentru Chimie și Petrochimie - ICECHIM	-	-	-	-	-	-	-	-	-	-	-	-	-
35	Univ. din Craiova - UCV	-	-	-	-	-	-	-	-	-	-	-	-	-
36	Inst. de Chimie Macromoleculară "Petru Poni" Iași - ICMPP	-	-	-	-	-	-	-	-	-	-	-	-	-
37	Univ. Tehnică Gheorghe Asachi din Iași - TUASI	-	-	-	-	-	-	-	-	-	-	-	-	-
38	SC Chemi Ceramic F SRL - CHEMICER	-	-	-	-	-	-	-	-	-	-	-	-	-
39	Inst. de Biologie și Patologie Celulară "NICOLAE SIMIONESCU" - IBPC	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Univ. de Medicină și Farmacie "Iuliu Hațieganu" - UMF CN	-	-	-	-	-	-	-	-	-	-	-	-	-
41	Univ. Petrol-Gaze din Ploiești - UPG	-	-	-	-	-	-	-	-	-	-	-	-	-
42	Centrul de Microscopie-Microanaliză și Procesarea Informației, Univ.	-	-	-	-	-	-	-	-	-	-	-	-	-
43	Facultatea de Științe Aplicate, Univ. Politehnica București - PSA/UPB	-	-	-	-	-	-	-	-	-	-	-	-	-
44	INCD în Domeniul Patologiei și Științelor Biomedicale "Victor Babes" -	-	-	-	-	-	-	-	-	-	-	-	-	-
45	Univ. Dumarea de Jos Galați - Centrul de Competențe (Cercetare) Interfețe -	-	-	-	-	-	-	-	-	-	-	-	-	-
46	INCD pentru Inginerie Electrică - Cercetări Avansate - INCDE ICEPE CA	-	-	-	-	-	-	-	-	-	-	-	-	-
47	S.C. Honeywell România S.R.L. - HON	-	-	-	-	-	-	-	-	-	-	-	-	-
48	INCD pentru Fizică Tehnică - INCDFT-IFT Iași	-	-	-	-	-	-	-	-	-	-	-	-	-
49	SC DDS Diagnostic SRL - DDS	-	-	-	-	-	-	-	-	-	-	-	-	-
50	Univ. Politehnica București - Laboratorul pentru Controlul Calității	-	-	-	-	-	-	-	-	-	-	-	-	-
51	INCD pentru Ecologie Industrială - INCD ECOIND	-	-	-	-	-	-	-	-	-	-	-	-	-
52	SC ECODET ACTIV SRL - EA	-	-	-	-	-	-	-	-	-	-	-	-	-
53	SC ROM QUARTZ SA - RQ	-	-	-	-	-	-	-	-	-	-	-	-	-
54	INCD pentru Științe Biologice - INCO SB	-	-	-	-	-	-	-	-	-	-	-	-	-
55	Inst. de Mecanica Solidelor al Academiei Române - IMSAR	-	-	-	-	-	-	-	-	-	-	-	-	-

National: initial review [4]

Thank you for your attention

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