Nanomaterialele si nanotehnologiile in PC7

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Sumarul prezentarii

- Prioritati de cercetare in PC7
- Bugetul pentru PC7
- Prioritatea IV din PC7
- Necesitatea coordonarii activitatii de cercetare cu necesitatiile industriei europene
- Concluzii

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Noua directii de cercetare in PC7

- I.Health
- II.Food, agriculture and biotechnology
- III.Information and communication technologies
- IV. Nanosciences, nanotechnologies, materials and new production technologies
- V.Energy
- VI.Environment (including climate change)
- VII.Transport (including aeronautics)
- VIII.Socio-economic sciences and the humanities
- IX. Security and Space

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Bugetul alocat pentru PC7: 72.726 milioane €

	FP7 EC (cash prices)									
	Themes	Health	Biotech, Food, Agriculture	Information Society	Nano, Materials, Production	Energy	Environment	Transport	Socio-economic Research	Space and Security	
COOPERATION	Collaborative Research	8,317	2,455	12,670	4,832	2,931	2,535	5,940	792	3,960	44,432
IDEAS	European Research Council										11,862
PEOPLE	Marie Curie Actions										7,129
CAPACITIES	Research Infrastructures	Research for, and by, SMEs		Regions of Knowledge	Research Potential	Science in Society	International Co-operation				7,486
	3,961	1,901		158	554	554	358				
JRC (EC)											1,817
										Total	72,726

Draft, Sursa: Comisia Europeana

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IV.Nanosciences, nanotechnologies, materials and new production technologies

Overall objective: improve the competitiveness of EU industry (including SMEs) and ensure its transformation through:

- the effective transition from a resource-based to knowledge-based industry
- generation of new breakthrough, applicable, knowledge
- strengthening EU leadership in nano, materials and production technologies
- emphasis on integrating different technologies and disciplines across many sectors

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Sursa: Comisia Europeana

Directii de cercetare in Prioritatea IV din PC7

1. Nanosciences and nanotechnologies
2. Materials
3. New production
4. Integration of technologies for industrial applications

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Sursa: Comisia Europeana

Directii de cercetare in Prioritatea IV

1. Nanosciences and nanotechnologies

Objective: increase and support the take up of knowledge generated in this revolutionary field for all industrial sectors

- *Topics include: interface and size dependent phenomena; materials properties at nano-scale; self assembly; metrology; new concepts and approaches; impacts on health and safety; convergence of emerging technologies*

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Sursa: Comisia Europeana

Directii de cercetare in Prioritatea IV

2. Materials

Objective: generate new knowledge to enable new industrial products and processes to be achieved, exploiting the potential of interdisciplinary approaches in materials research.

- *Topics include: high performance, sustainable and knowledge-based materials; design and simulation; nano-, bio- and hybrid materials and their processing; chemical technologies and materials processing industries*

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Sursa: Comisia Europeana

Directii de cercetare in Prioritatea IV

3.New production

Objective: create continuously innovating production capabilities to achieve leadership in industrial products & processes in the global marketplace.

- *Topics include: Knowledge-intensive production; new paradigms for emerging industrial needs; adaptive, networked and knowledge-based production; convergence of technologies for next generation of high value-added products (nano, bio, info, cognitive..)*

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Sursa: Comisia Europeana

Directii de cercetare in Prioritatea IV

4. Integration of technologies for industrial applications

Objective: accelerate the rate of industrial transformation by exploiting the application potential of new generic technologies

- *Topics include: Integration of nano, materials and production technologies in sectoral and cross-sectoral applications (e.g. health, construction, transport, energy, chemistry, environment, textiles & clothing, pulp & paper, mechanical engineering)*

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Sursa: Comisia Europeana

Repere in Programul Cadru 7

- “Emphasis on industry-driven character of Technology Initiatives”

Este important sa coordonam activitatile de cercetare cu necesitatile industriei la nivel european !

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Sursa: Comisia Europeana

Microelectronica "forta motrice" pentru stiinta si tehnologia materialelor ultimele decenii

CMOS Periodic Table, 1970's

IA	*IIA*	*IIIB*	*IVB*	*VB*	*VIB*	*VIIB*	*VIII*			*Ib*	*IIb*	*IIIA*	*IVA*	*VA*	*VIA*	*VIIA*	*VIIIA*
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

After R.M.Wallace, Univ. of Texas

12 elemente folosite !

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Microelectronica "forta motrice" pentru cercetarea in zona de noi materiale si noi tehnologii in ultimele decenii

CMOS Periodic Table, 1980's

IA	*IIA*	*IIIB*	*IVB*	*VB*	*VIB*	*VIIB*	*VIII*			*Ib*	*IIb*	*IIIA*	*IVA*	*VA*	*VIA*	*VIIA*	*VIIIA*
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Numai 4 noi elemente au fost integrate in tehnologiile CMOS !

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After R.M.Wallace, Univ. of Texas

Microelectronica ramine "forta motrice" pentru dezvoltarea nanomateriale si nanotehnologii pentru urmatorul deceniu

ULSI CMOS Periodic Table, 2005's

IA	*IIA*	*IIIB*	*IVB*	*VB*	*VIB*	*VIIB*	*VIII*			*Ib*	*IIb*	*IIIA*	*IVA*	*VA*	*VIA*	*VIIA*	*VIIIA*
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

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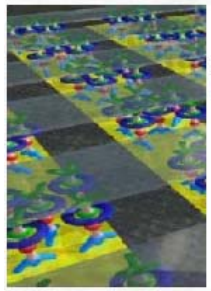
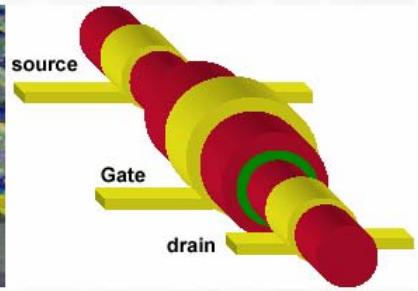
Microelectronica "forta motrice" pentru inovatie in nanomateriale si nanotehnologii pentru urmatorul deceniu

Beyond CMOS

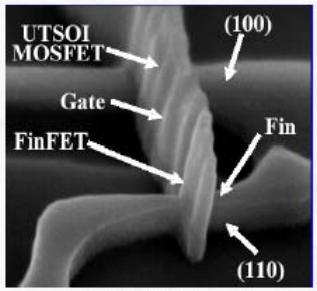
Future
15 years
Non-classical CMOS



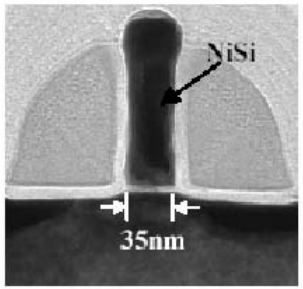


Molecular Switches ?
Nanowire Transistor ?

Tomorrow



CMOS
pMOS FINFET

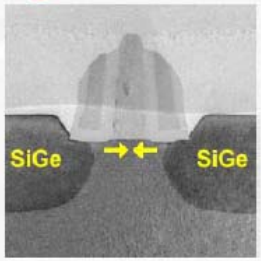


New Materials

45 nm Node
Lg < 25 nm

16 nm Node
Lg ~ 6 nm

Today
90 nm Node
Lg ~ 45 nm



Strain
Enhanced Mobility

Necesita inventarea de noi materiale nanostructurate si nanotehnologii

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Sursa: A.C. Diebold, Sematech

Microelectronica "forta motrice" pentru inovatie in nanomateriale si nanotehnologii pentru urmatorul deceniu

Piatra de temelie a unui circuit integrat este tranzistorul

Obiectivele in design-ul unui tranzistor:

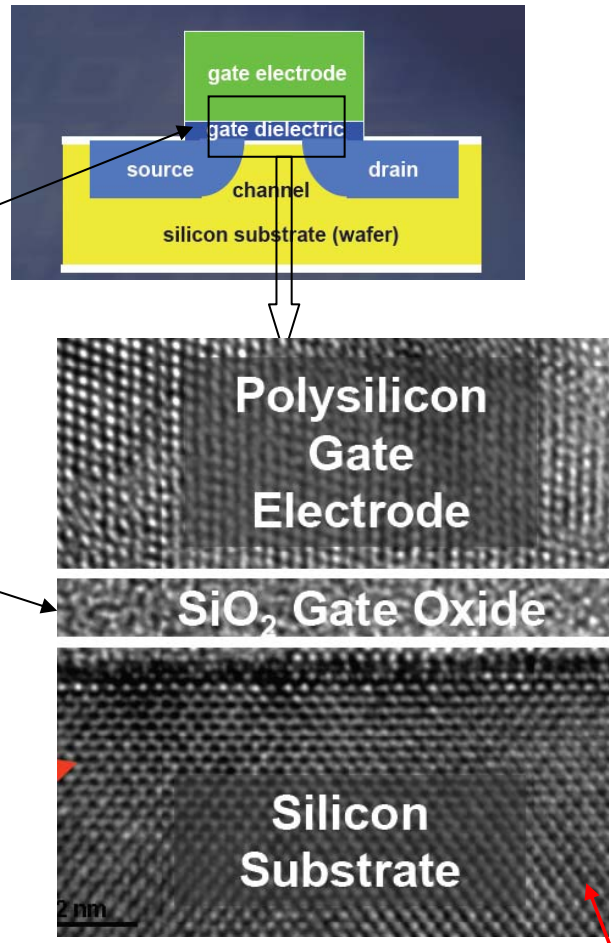
-mai mic, mai rapid, mai ieftin, mai putin consumator de energie

Tranzistoarele mai mici sunt mai rapide, mai ieftine dar…

oxidul de poarta (SiO_2) are grosimea numai a citeva straturi atomice

SiO_2 este un dielectric excelent dar la aceasta grosime incepe sa fie strapuns…

Analogie: un robinet care incepe sa nu se mai inchida perfect…



Sursa : Intel

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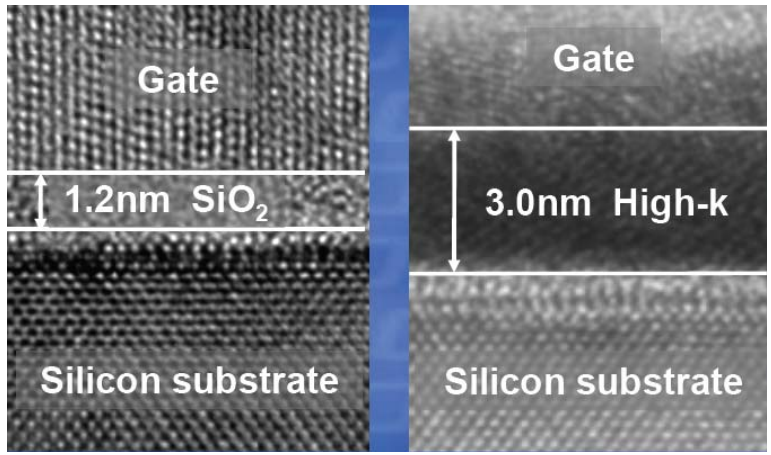
Microelectronica "forta motrice" pentru inovatie in nanomateriale si nanotehnologii pentru urmatorul deceniu

-Un inlocuitor pentru SiO_2 trebuie gasit pentru a continua cursa pentru tranzistoare mai mici, mai rapide, mai ieftine si mai putin gurmande

Teoretic avem o simpla solutie: un material (high-k) cu constanta dielectrica mai mare poate fi mai gros pastrind acelasi C/arie pentru I_{s-d} ….



dar inca ramine de gasit un alt oxid (material) care sa aiba proprietati dielectrice si de interfata cit mai apropiate de cele are SiO_2 …

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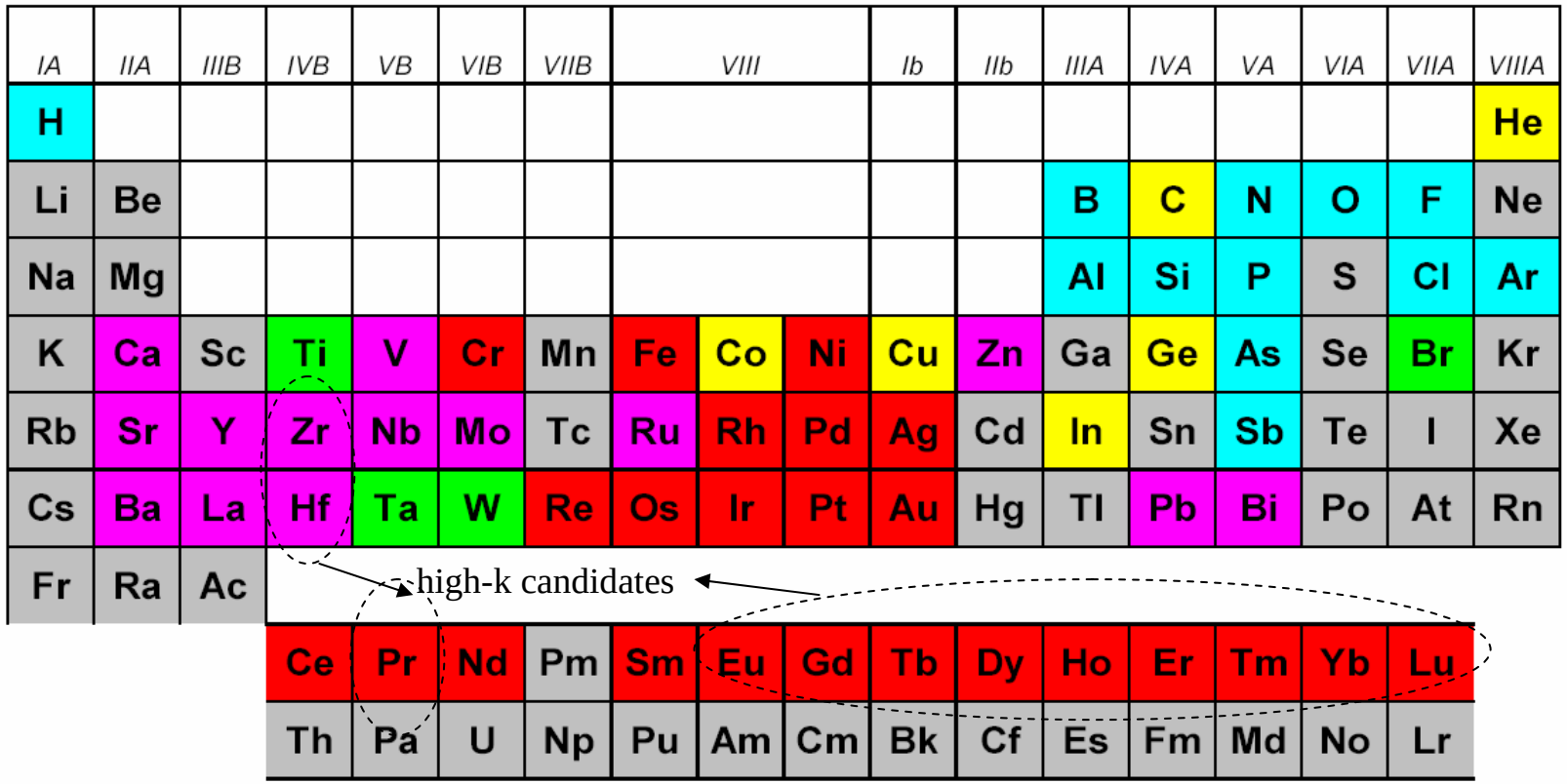
Sursa : Intel

Microelectronica ramine "forta motrice" pentru dezvoltarea nanomateriale si nanotehnologii pentru urmatorul deceniu

Cursa pentru gasirea unui inlocuitor pentru SiO_2 ramane deschisa !



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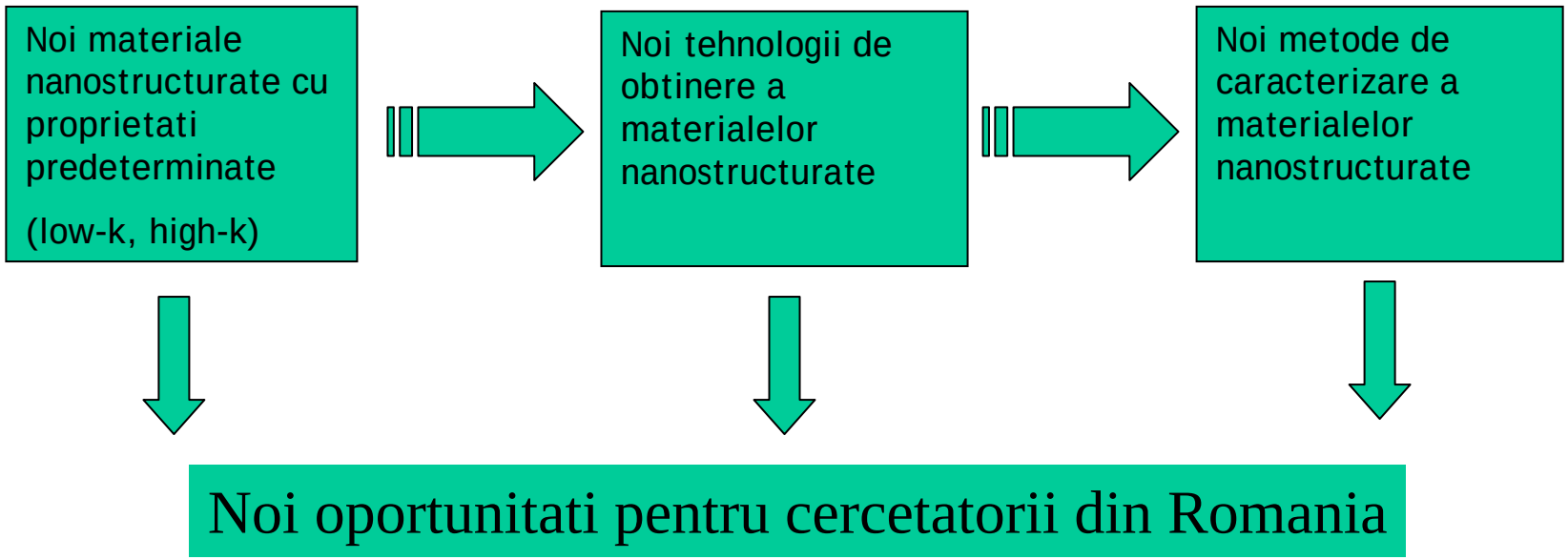
Microelectronica "forta motrice" pentru dezvoltarea de noi nanomateriale si nanotehnologii pentru urmatorul deceniu

- Cresterea complexitatii circuitelor microelectronice determina industria microelectronica sa devina mare "consumatoare" de noi nanomateriale si nanotehnologii



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Materiale semiconductoare transparente (TCOs)

TCOs materiale cu proprietati fizice unice: co-existenta proprietatilor semiconductoare cu transparenta in domeniul spectral visibil

Exemple tipice pentru TCOs tip n: ITO (In_2O_3 dopat cu SnO), SnO, ZnO

Aplicatii tipice : display-uri flat panel (ITO), geamurile termopan (SnO)

Un interes tehnologic important il prezinta materialele TCOs de tip p cu nebanuite posibile implicatii in viata noastra de zi cu zi

Posibile aplicatii:

- electronica si optoelectronica transparenta (circuite invizibile),
- diodele LED utilizind materiale organice (OLED-uri)
- microsenzori intregati bazati pe principii electro-optice (ghiduri de unda)
- arhitectura ambientala –ferestrele inteligente multifunctionale
- dispozitive fotovoltaice

Cercetari intense au loc pe plan mondial pentru descoperirea unor materiale TCOs de tip p…

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Concluzii:

- Prioritatea IV din PC 7 este oportunitate pentru cercetarea din Romania
- Nanomateriale si nanotehnologiile necesita abordari interdisciplinare complexe unde cercetarea fundamentala va avea un rol important
- Nanomateriale nu implica numai scalarea unor materiale deja cunoscute la grosimi sau dimensiuni nanometrice ci si descoperirea (“inventarea”) de materiale noi cu proprietati predeterminate (electrice, magnetice, optice, chimice etc).
- Nanotehnologiile necesita dezvoltarea de concepte noi, inovatoare in stiinta nanomaterialelor
- Nanomaterialele si nanotehnologiile au nevoie de noi metodologii (instrumente) de caracterizare adaptate pentru a atinge rezolutii la scara subnanometrica. Multe din aceste metodologii (instrumente) ramin inca sa fie descoperite

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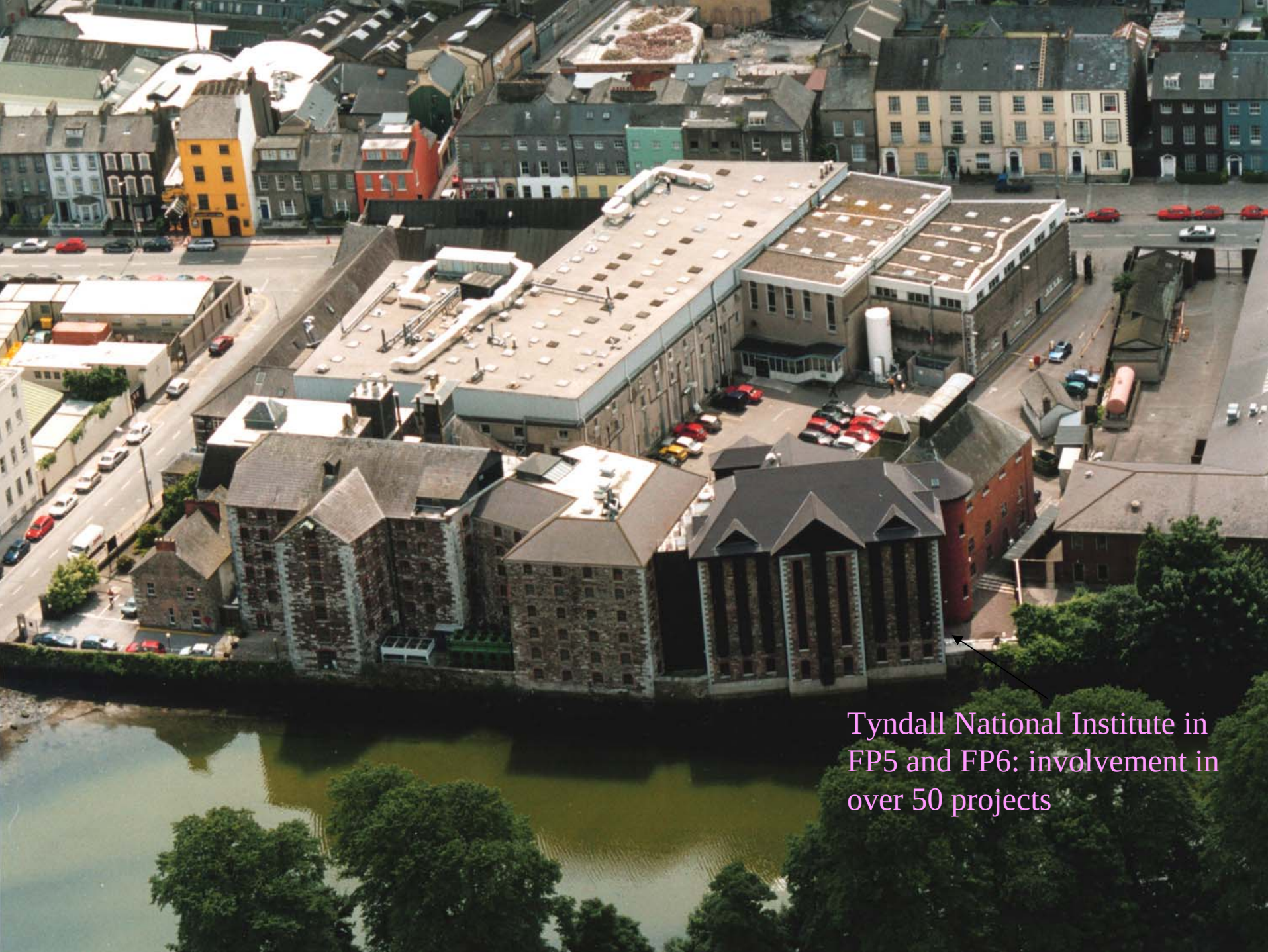
Tyndall National Institute in FP5 and FP6: involvement in over 50 projects