MINISTERIO DE INDUSTRIA, ENERGIA Y TURISMO

Oficina Española de Patentes y Marcas

Europäisches Patentamt
European Patent Office
Office européen des brevets

Patenting procedures in the field of nanotechnology

Programme

27–28 October 2015
Madrid, Spain

A joint SPTO-EPO initiative,
organised by STPO

Speakers

Dr. Victor Veefkind
Examiner
Joint Cluster Industrial Chemistry, European Patent Office, The Hague

Victor Veefkind has a degree in chemistry and a PhD in chemical engineering with emphasis on catalysis and materials science. He furthermore holds a Master's degree in Intellectual Property and Technology Law and passed the EQE. Vicotor joined the EPO in 1999. As an examiner in search, examination and opposition, he has been responsible for several technical fields in industrial chemistry. Furthermore he has been initiator and project leader for the climate change mitigation technologies classification Y02.
Currently, apart from being an examiner, he is an expert for the directorate patent practice and procedures and co-chair of the nanotechnology working group. In the latter capacity he has been involved in the creation of the IPC class B82Y for nanotechnology.

Dr. Birgit Lewis
Examiner
Joint Cluster Biotechnology, European Patent Office, Munich

Birgit Lewis holds a PhD in Molecular Biology from the University of Vienna. Her PhD thesis was done at the Research Institute for Molecular Pathology (IMP) in Vienna.
She worked in the patent department of a pharmaceutical company in Vienna before she joined the EPO as a patent examiner in 1996.
At the EPO, she works mainly in the fields of Virology and Gene Therapy as an examiner in search, examination and opposition. She is a classifier in the fields of Virology, Gene Therapy, Nanobiotechnology and Nanomedicine.

Dr. Gabriel González Limas
Head of Service of Chemical Patents II (Biotechnology and Food Technology) at the Spanish Patent and Trademark Office (SPTO)

Gabriel González Limas holds a PhD in Biochemistry from the University Complutense (UCM), Madrid. His PhD thesis was done at the Hospital "Ramón y Cajal" in Madrid.
He joined the SPTO as a patent examiner in 1991, working in the fields of Chemistry, Pharmaceutics, Biotechnology, Environment and related technical fields. He represented the SPTO at industrial fairs, training courses and seminars on Industrial Property to promote new technologies in the Spanish industries.
Since 2008, he is the Head of Service of Chemical Patents II at the SPTO, heading and managing a team of 21 patent examiners.

Verónica Balmaseda Valencia
Examiner
Chemistry and Metallurgy
Spanish Patent and Trademark Office (SPTO)

Verónica Balmaseda graduated in Chemical Science and holds a degree in Analytical Chemistry from the University Complutense (UCM), Madrid. She worked in the R&D department of an environmental company in Madrid before she joined the SPTO as a patent examiner in 2002.
At the SPTO, she works mainly in the field of Inorganic Chemistry (Materials Science and Catalyst).

Dr. María del Mar García Poza
Examiner
Chemistry and Metallurgy
Spanish Patent and Trademark Office (SPTO)

Maria del Mar Garcia Poza holds a PhD in Physics Sciences from the Universidad Autónoma de Madrid.
She worked as a patent attorney in a private Italian company with a branch office in Madrid before she joined the SPTO as a patent examiner in 2008.
At the SPTO, she works mainly in the field of inorganic materials.

Tuesday, 27 October 2015

Workshop: SPTO – EPO Patent Examiners

08.45 **Registration**

09.00 **Welcome speech**
Ms Isabel Seriñá Ramírez, SPTO
Mr Antoine Rety, European Patent Academy, EPO

09.15 **Classification and search practice in the field of nanotechnology**
Patent Examiners, SPTO and EPO

10.30 Coffee break

11.00 **Examination practice in the field of nanotechnology**
Patent Examiners, SPTO and EPO

12.00 **EPO case law in the field of nanotechnology**
Patent Examiners, EPO

12.30 Lunch break

13.30 **Case studies and discussion of files**
Patent Examiners, SPTO and EPO

15.00 Coffee break

15.30 **Case studies and discussion of files – continued**
Patent Examiners, SPTO and EPO

16.15 **Questions and answers**

17.00 **End of the workshop**

Wednesday, 28 October 2015

Roundtable: Spanish nanotech industry and patent attorneys – SPTO – EPO

08.45 **Registration**

09.00 **Welcome speech**
Ms María José de Concepción Sánchez, SPTO
Mr Antoine Rety, European Patent Academy, EPO

Moderator of the roundtable:
Mr Gabriel González Limas, SPTO

09.15 **Patenting trends and classification of nanotechnology inventions: what is patented in the field and how to search for it**
Ms Birgit Lewis and Mr Victor Veefkind, Examiners, EPO
Ms María del Mar García Poza, Examiner, SPTO

10.00 **Examination practice in the field of nanotechnology, including EPO case law**
Ms Birgit Lewis and Mr Victor Veefkind, Examiners, EPO
Ms Verónica Balmaseda Valencia, Examiner, SPTO

10.45 Coffee break

11.15 **The patenting experience of a Spanish nanotech company**
Mr Antonio Páez Dueñas, Senior R&D Advisor, REPSOL

11.40 **The patenting experience of a Spanish nanotech company**
Mr Javier Menéndez, CEO, NANOBIOMATTERS

12.05 **The patenting experience of a Spanish nanotech Technological Centre**
Mr Bonifacio Vega, Technology Transfer and development Manager, IMDEA

12:30 **The patenting experience of a Spanish University**
Ms Susana Torrente, Technology Transfer Officer, University of Santiago de Compostela

12.55 **Questions and answers**

13.30 **Closing remarks**
Mr Gabriel González Limas, SPTO
Mr Antoine Rety, European Patent Academy, EPO

13.45 **End of the roundtable**

14.00 Snacks on the premises of the Spanish Patent Office

Imprimir todas las ponencias

Ver video

Venue
Spanish Patent and Trademark Office
Paseo de la Castellana 75
28046 Madrid
Spain

Seminar reference
OT06-2015

European Patent Academy
European Patent Office
Bob-van-Benthem-Platz 1
80469 Munich
Germany
Tel. +49 89 2399 5454
academy@epo.org
www.epo.org

www.epo.org/learning

Europäisches Patentamt
European Patent Office
Office européen des brevets

Patenting trends and classification of nanotechnology inventions:

what is patented in the field and how to search for it

Birgit Lewis, Victor Veefkind

Madrid, 28 October 2015

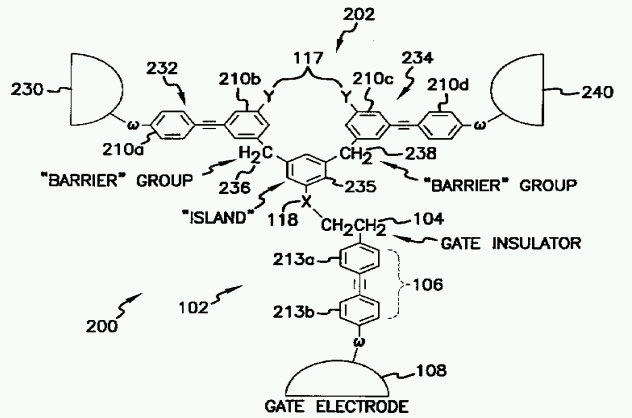
Nanotechnology

Wikipedia:

- The manipulation of matter with at least one dimension sized from 1 to 100 nanometers.
- Nanotechnology as defined by size is naturally very broad, including fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, etc.
- The associated research and applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale.

Interdisciplinary

Chemistry or Electronics?



SINGLE MOLECULE TRANSISTOR

Patent Information

- Patent trends in nanotechnology?
- How can I find patent applications from myself or from competitors?
- Can I use this also to keep track of technological developments in my field?

Use patent classification!

- Not dependent on exact use of words.
  - IPC = International Patent Classification : @ 70 000 entries
  - CPC = Cooperative Patent Classification (new!) @ 250 000 entries

- Some examples:
  - C01B31/02: Production of carbon (including carbon nanotubes)
  - G06N3/00: Computer systems based on biological models (including biomolecular computers)
  - H01L31/0352: Semiconductor devices with relative sizes of regions (includes superlattices)

Please credit photo to NASA Ames Research Center

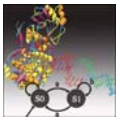
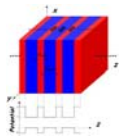


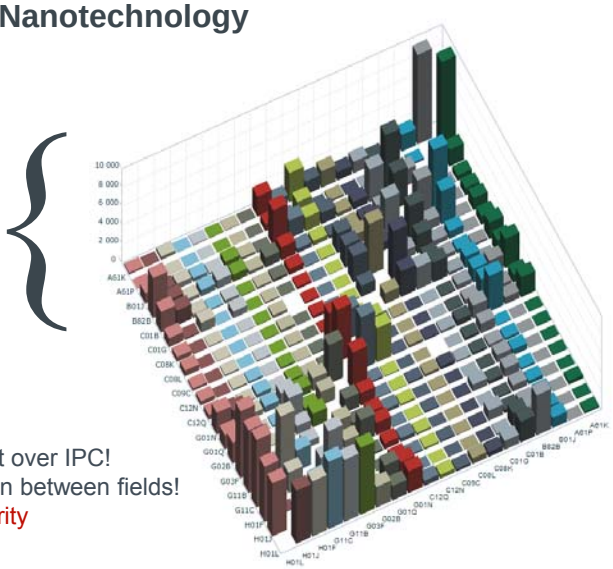
Figure 2 based on work published in Benenson Y., R. Adar, T. Paz-Elizur, Z. Livneh, and E. Shapiro. "DNA molecule provides a computing machine with both data and fuel." *Proc Natl Acad Sci U.S.A.* 100, no. 5 (March 4, 2003): 2191-6.



Wikipedia Commons, public domain

IPC v. IPC for Nanotechnology

✓ B82Y tags!



- Fields spread out over IPC!
- Large interrelation between fields!
  - Interdisciplinarity

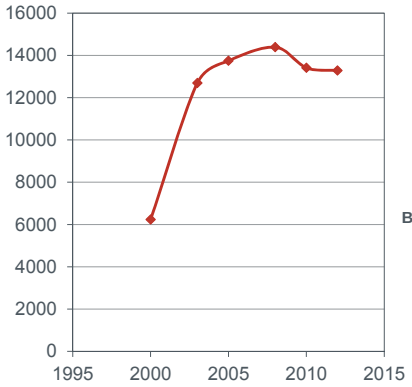
Nanotechnology : B82Y

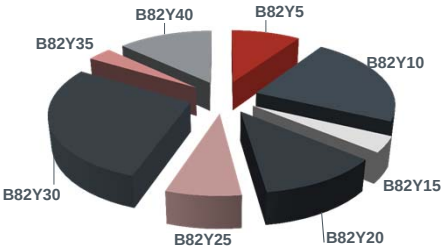
B82Y5	30,000	Nanobiotechnology or nano-medicine
B82Y10	70,000	Nanotechnology for information processing, storage and transmission
B82Y15	12,000	Nanotechnology for interacting, sensing and actuating
B82Y20	37,000	Nanotechnology for optics
B82Y25	23,000	Nanomagnetism
B82Y30	88,000	Nanotechnology for materials and surface science
B82Y35	11,000	Methods or apparatus for measurement or analysis of nanostructures
B82Y40	41,000	Manufacture or treatment of nanostructures

In total nearly 240 000 documents classified as nanotechnology!

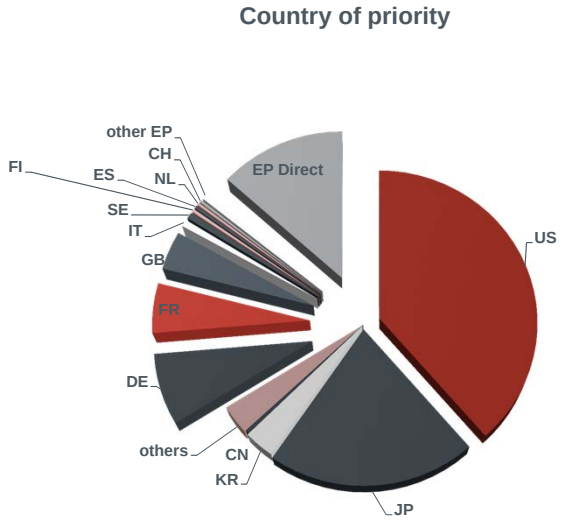
Some trends in nanotechnology patenting

Applications world-wide per year

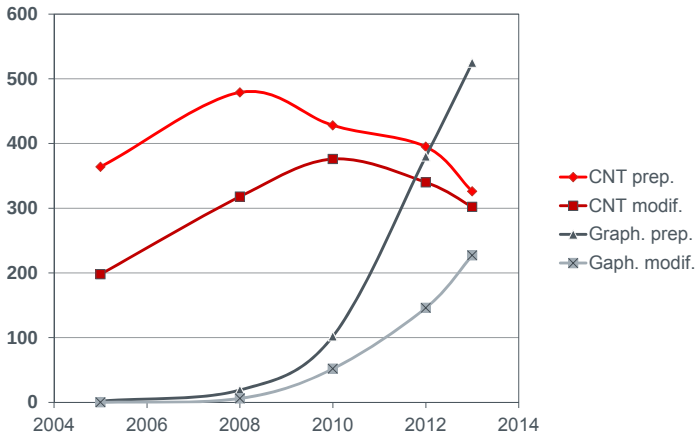




Origin of EP applications in B82Y



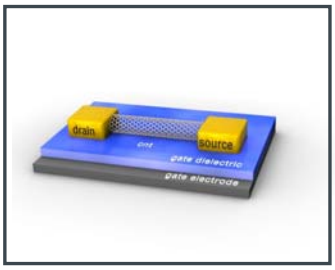
CNTs/graphene patenting world-wide over time

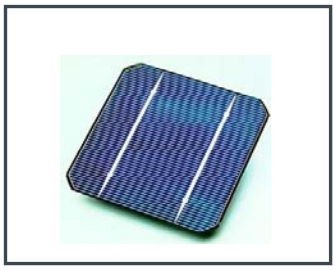


Nanotechnology in "clean energy" applications

Use tagging for nanotechnology and tagging for CCMT in energy sector:

B82Y **and** **Y02E**





14700 patent documents

Very high growth rates!

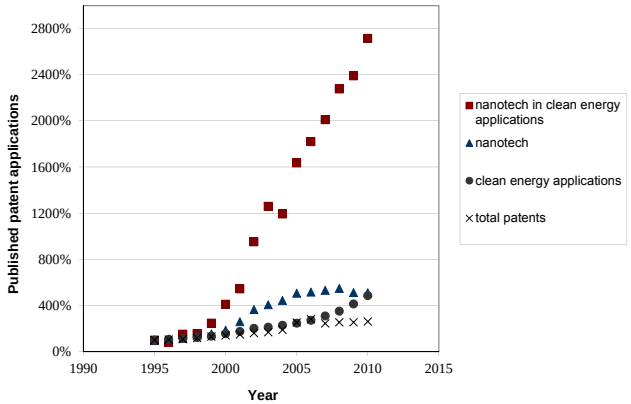


Figure 1, relative growth of patent applications (1995=100%)

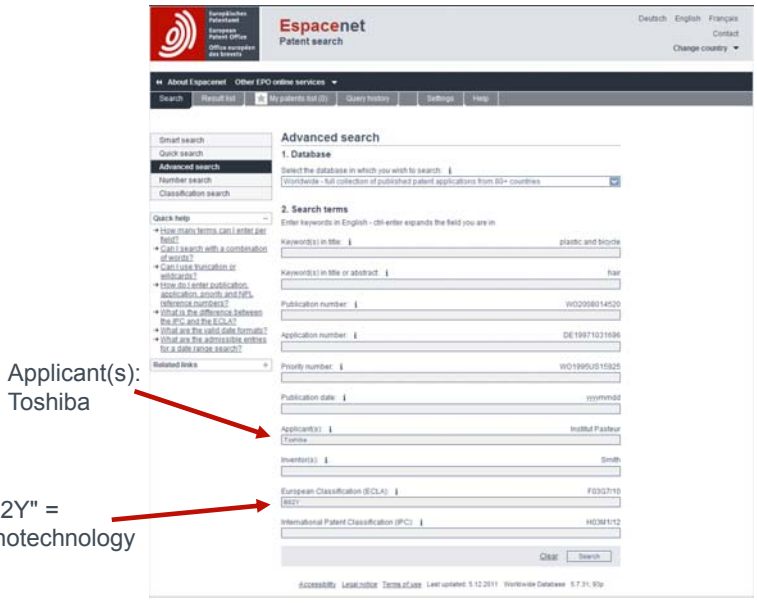
1995 = 100%

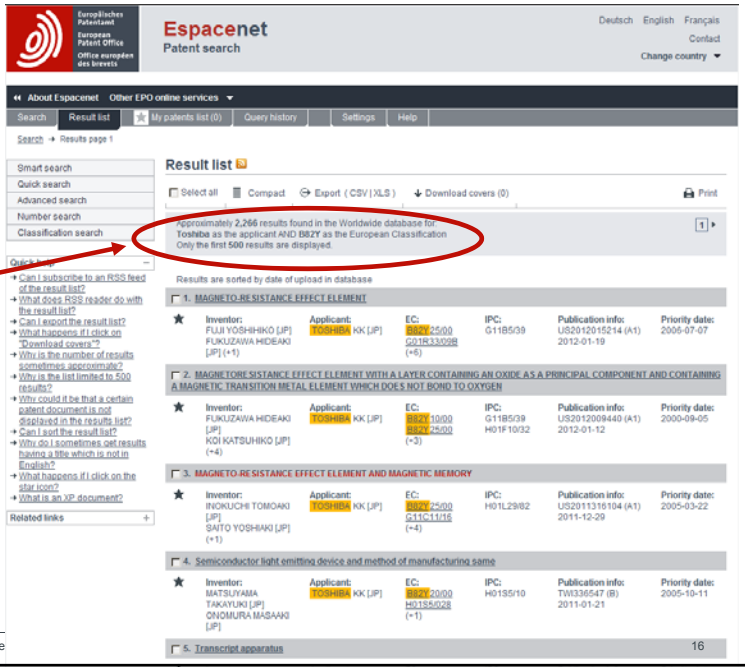
Trends in nanotechnology patenting (subjective)

- From synthesis of nanoparticles/ nanotubes to modification of nanoparticles/ nanotubes
- From CNTs to graphene
- Use of CNTs as material to improve bulk properties of materials or components in all kinds of fields, from tires to cooling devices, making use of the excellent conductive properties and strength of CNTs seems to outweigh specific nanotech use..
- Nanotechnology for clean energy applications (esp. solar cells, battery/ fuel cell technologies and hydrogen storage materials).

How to search:

- Use same database as EPO examiners:
  - via *Espacenet*: free and accessible via OMPI in Spanish


Espacenet
Patent search
Deutsch English Français
Contact
Change country
About Espacenet Other EPO online services
Search Result list My patents list (0) Query history Settings Help
Smart search
Quick search
Advanced search
Number search
Classification search
Advanced search
1. Database
Select the database in which you wish to search:
Worldwide - full collection of published patent applications from 80+ countries
2. Search terms
Enter keywords in English - ctrl-enter expands the field you are in
Keyword(s) in title:
plastic and bicycle
Keyword(s) in title or abstract:
hair
Publication number:
WO2008014520
Application number:
DE19971031696
Priority number:
WO1995US15825
Publication date:
yyyymmdd
Applicant(s):
Institut Pasteur
Toshiba
Inventor(s):
Smith
European Classification (ECLA):
F03G7/10
B82Y
International Patent Classification (IPC):
H03M1/12
Clear
Search
Applicant(s): Toshiba
"B82Y" = Nanotechnology


Espacenet
Patent search
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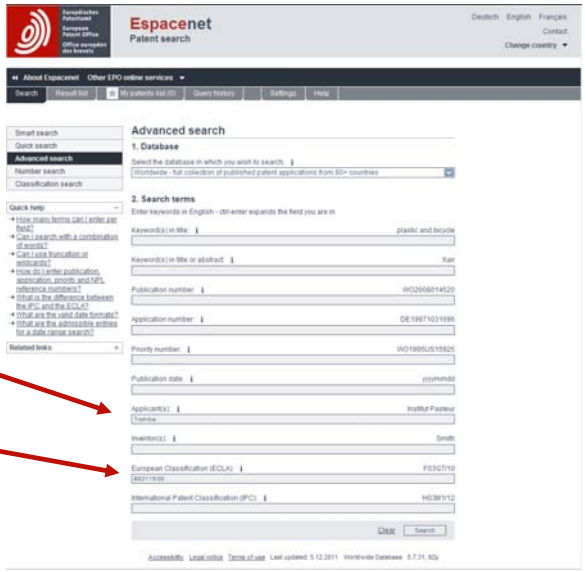
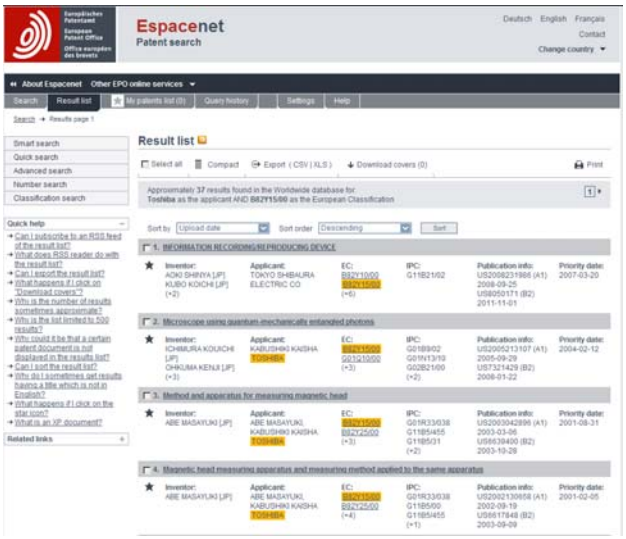
Contact
Change country
About Espacenet Other EPO online services
Search Result list My patents list (0) Query history Settings Help
Search → Results page 1
Result list
Select all Compact Export (CSV | XLS) Download covers (0) Print
Approximately 2,266 results found in the Worldwide database for
Toshiba as the applicant AND B82Y as the European Classification
Only the first 500 results are displayed.
Results are sorted by date of upload in database
1. MAGNETO-RESISTANCE EFFECT ELEMENT
2. MAGNETORESISTANCE EFFECT ELEMENT WITH A LAYER CONTAINING AN OXIDE AS A PRINCIPAL COMPONENT AND CONTAINING A MAGNETIC TRANSITION METAL ELEMENT WHICH DOES NOT BOND TO OXYGEN
3. MAGNETO-RESISTANCE EFFECT ELEMENT AND MAGNETIC MEMORY
4. Semiconductor light emitting device and method of manufacturing same
5. Transcript apparatus
Smart search
Quick search
Advanced search
Number search
Classification search
Related links
2266 results!

Example

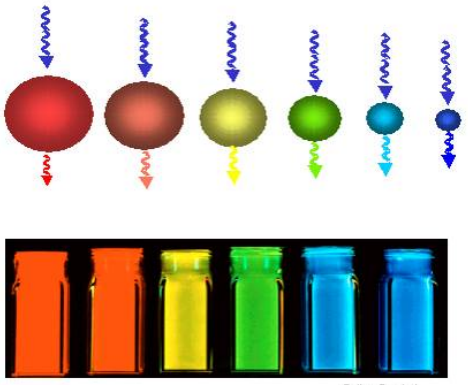


Results!



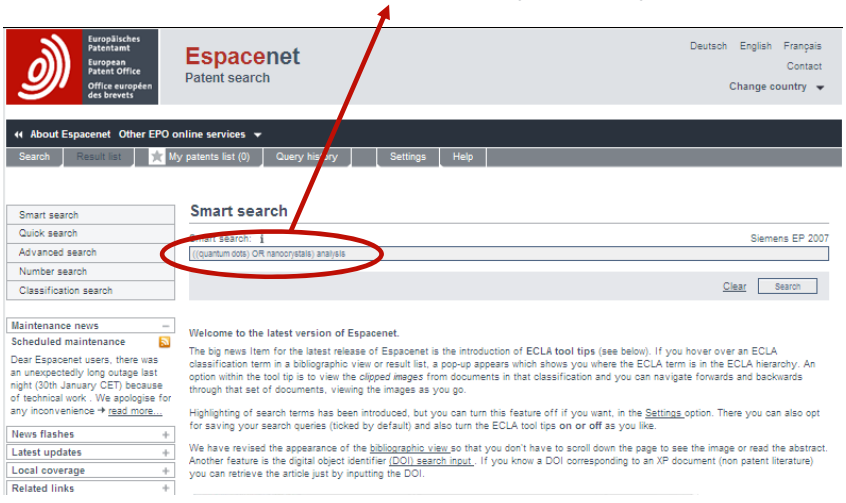
Example *Espacenet*

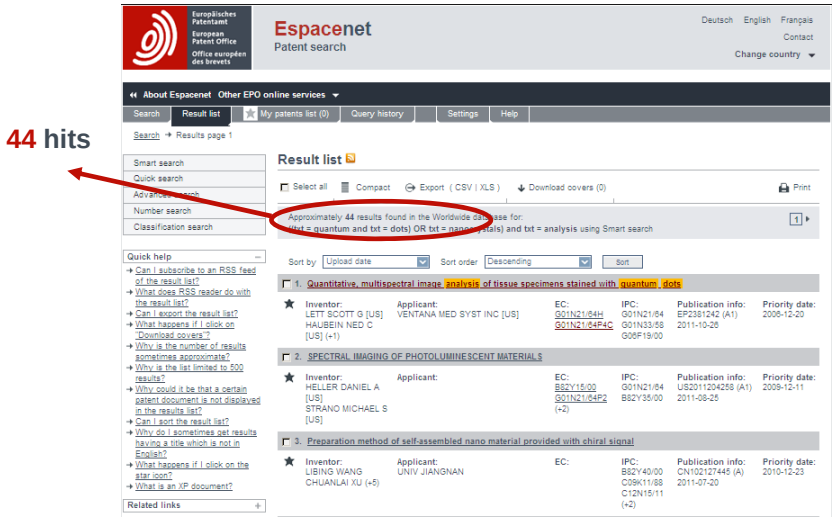
Semiconductor nanocrystals for labelling

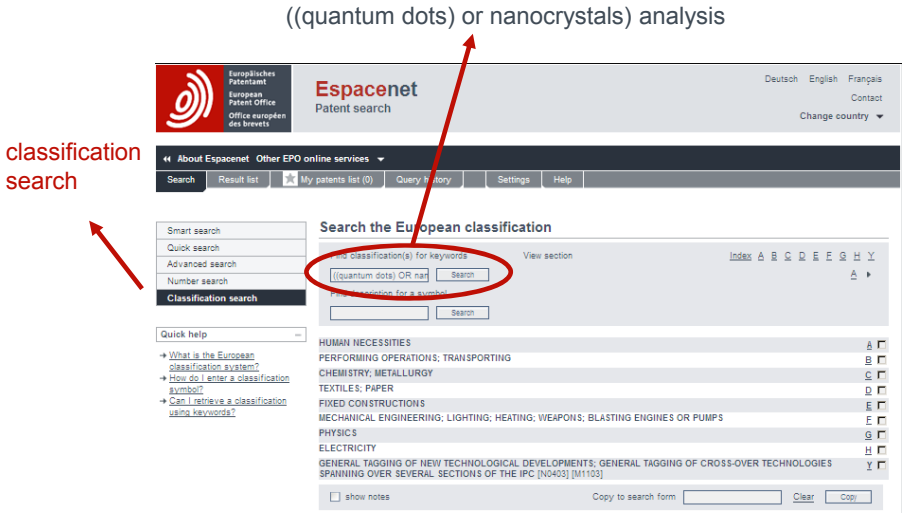


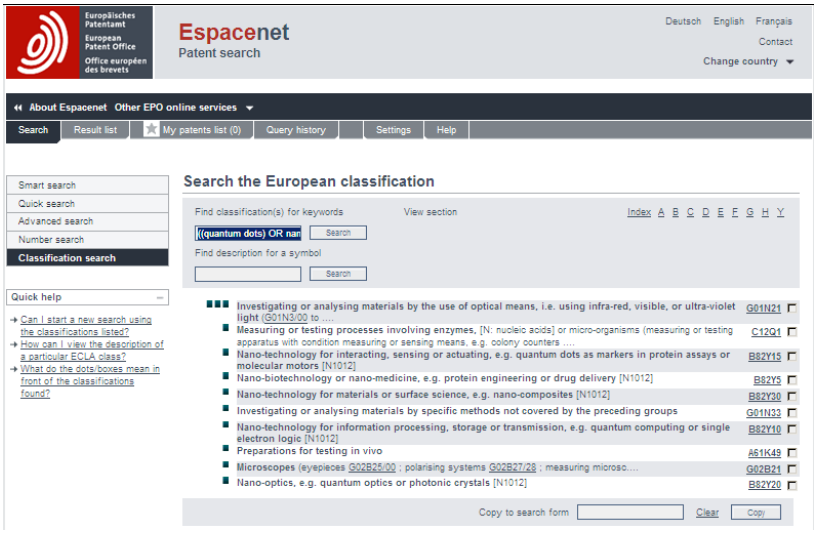
Felice Frankel

((quantum dots) or nanocrystals) analysis



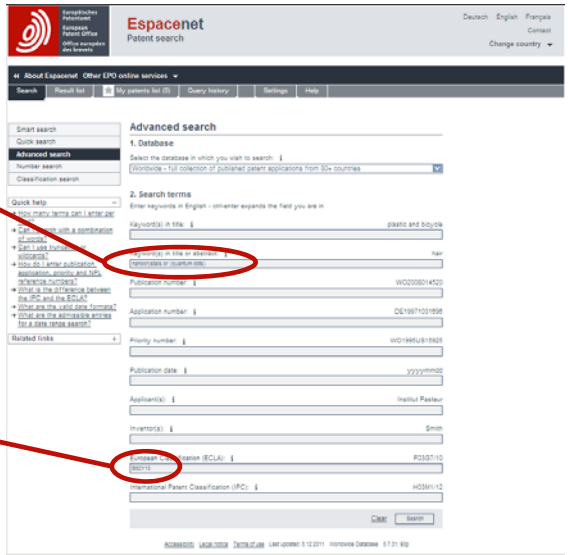

44 hits
Espacenet
Patent search
Result list
Approximately 44 results found in the Worldwide database for:
((txt = quantum and txt = dots) OR txt = nanocrystals) and txt = analysis using Smart search
1. Quantitative, multispectral image analysis of tissue specimens stained with quantum dots
2. SPECTRAL IMAGING OF PHOTOLUMINESCENT MATERIALS
3. Preparation method of self-assembled nano material provided with chiral signal


((quantum dots) or nanocrystals) analysis
classification search
Espacenet
Patent search
Search the European classification
((quantum dots) OR nan
HUMAN NECESSITIES
PERFORMING OPERATIONS; TRANSPORTING
CHEMISTRY; METALLURGY
TEXTILES; PAPER
FIXED CONSTRUCTIONS
MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING ENGINES OR PUMPS
PHYSICS
ELECTRICITY
GENERAL TAGGING OF NEW TECHNOLOGICAL DEVELOPMENTS; GENERAL TAGGING OF CROSS-OVER TECHNOLOGIES SPANNING OVER SEVERAL SECTIONS OF THE IPC [N0403] [M1103]



(quantum dots) or nanocrystals

B82Y15

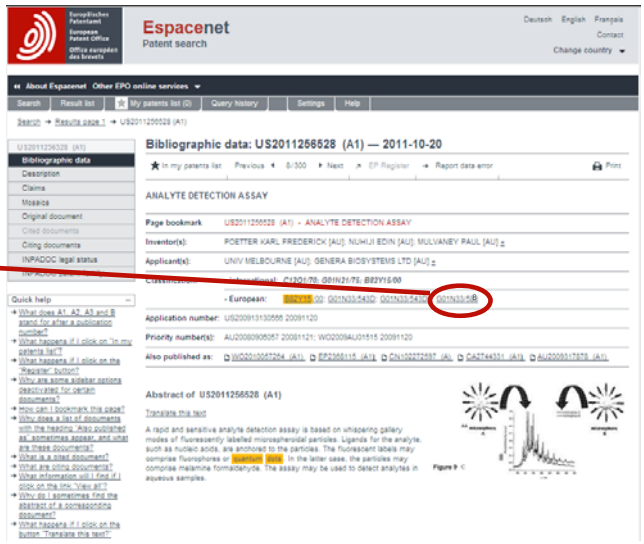


ANALYTE DETECTION ASSAY

Interesting!
Let's have a look.

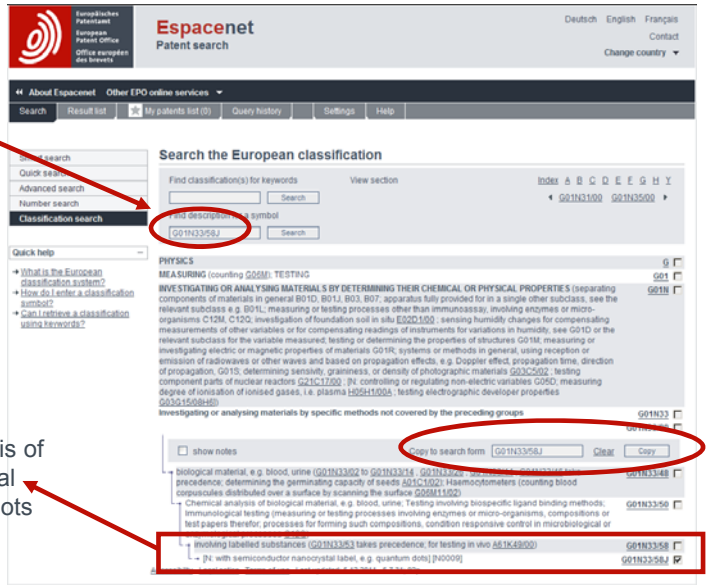
"G01N33/588"

Look up in Classification Search!

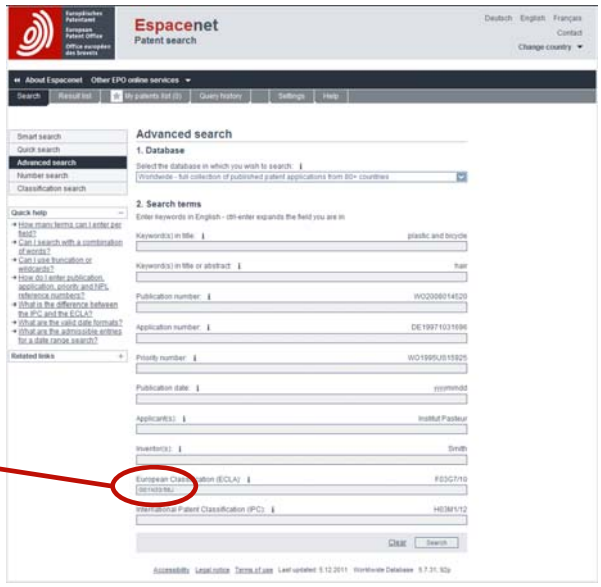


G01N33/588

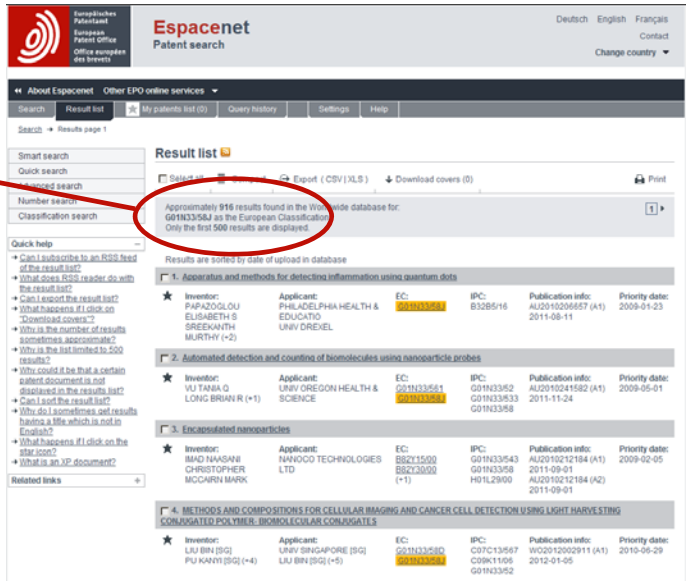
Chemical analysis of biological material using quantum dots



CPC:
G01N33/588



916 results!



Conclusions search

- use Espacenet!
- Suggested strategy:
  - use B82Y codes and some keywords as first pass.
  - Look at the results
  - Check CPC of most close results
  - Use this CPC for further search

Thank you for your attention!

Patenting trends and classification of nanotechnology inventions:
what is patented in the field and how to search for it

Mª del Mar García Poza
Verónica Balmaseda

Seminar OT06-2015
Madrid, 28 October 2015

NANOTECHNOLOGY INVENTIONS – nm size

Is an **Invention** new,
and inventive in comparison
to **the State of the Art?**

EXAMINERS

Searching

Statistics

Analysis

NANOTECHNOLOGY
PATENTS

RESEARCHERS

GOVERMENT

Non patent
literature

AGENDA

- ✓ Nanotechnology Inventions:
  - ✓ How to search for it: Definition of the search strategy
- ✓ Patenting trends in the world:
  - ✓ Countries, applicants
- ✓ Patenting trends in Spain:
  - ✓ Applicants
- ✓ Conclusions

Definition of the search strategy

1.- Selecting the **databases**
2.- **Classification** of the patent applications
3.- Selecting the **keywords**

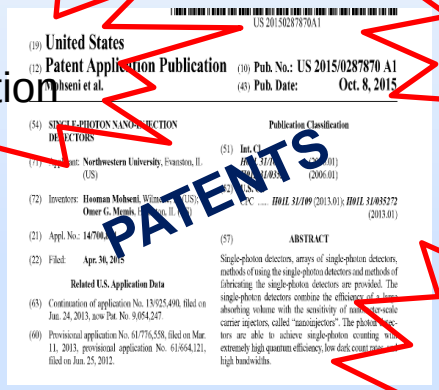
Is difficult to Search Nanotechnology in the State of the Art?

YES

classification

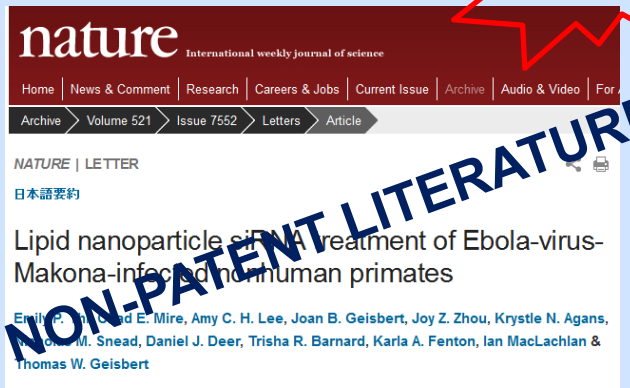
databases

PATENTS



keywords

NON-PATENT LITERATURE



MINISTERIO
DE INDUSTRIA, ENERGÍA
Y TURISMO

Oficina Española
de Patentes y Marcas

SELECTION OF DATABASES

INVENES

- Free access to Spanish patent documents
- From 1929 to today
- *Patent search*

http://invenes.oepm.es

Espacenet

- Free access to 90 million patent documents worldwide
- From 1836 to today
- *Patent Search*

http://worldwide.espacenet.com

PATSTAT: EPO Worldwide Patent Statistical Database

- For *statistical research*
- Updated versions: April and October
- Free trial: 2 months

https://www.epo.org/searching/subscription/patstat-online.html

THE OECD PATENT DATABASE

- For *statistical research*
- Update in July 2011
- Data from PATSTAT
- Patent applications to the European Patent Office, the US Patent and Trademark Office, patent applications filed under the Patent Co-operation Treaty that designate the EPO, as well as Triadic patent families.

https://stats.oecd.org

International Patent Classification (IPC)
Cooperative Patent Classification (CPC)

B82 NANO-TECHNOLOGY

B82B NANO-STRUCTURES FORMED BY MANIPULATION OF INDIVIDUAL ATOMS, MOLECULES, OR LIMITED COLLECTIONS OF ATOMS OR MOLECULES AS DISCRETE UNITS; MANUFACTURE OR TREATMENT THEREOF

B82Y SPECIFIC USES OR APPLICATIONS OF NANO-STRUCTURES; MEASUREMENT OR ANALYSIS OF NANO-STRUCTURES; MANUFACTURE OR TREATMENT OF NANO-STRUCTURES

B82B NANO-STRUCTURES FORMED BY *MANIPULATION OF INDIVIDUAL ATOMS, MOLECULES*, OR LIMITED COLLECTIONS OF ATOMS OR MOLECULES AS DISCRETE UNITS; MANUFACTURE OR TREATMENT THEREOF

B82B 1/00 Nano-structures formed by manipulation of individual atoms or molecules, or limited collections of atoms or molecules as discrete units

B82B 3/00 Manufacture or treatment of nano-structures by manipulation of individual atoms or molecules, or limited collections of atoms or molecules as discrete units

B82Y SPECIFIC USES OR APPLICATIONS OF *NANO-STRUCTURES*; MEASUREMENT OR ANALYSIS OF *NANO-STRUCTURES*; MANUFACTURE OR TREATMENT OF *NANO-STRUCTURES*

B82Y 5/00 Nano-biotechnology or nano-medicine, e.g. protein engineering or drug delivery
B82Y 10/00 Nano-technology for information processing, storage or transmission, e.g. quantum computing or single electron logic
B82Y 15/00 Nano-technology for interacting, sensing or actuating, e.g. quantum dots as markers in protein assays or molecular motors
B82Y 20/00 Nano-optics, e.g. quantum optics or photonic crystals
B82Y 25/00 Nano-magnetism, e.g. magnetoimpedance, anisotropic magnetoresistance, giant magnetoresistance or tunneling magnetoresistance
B82Y 30/00 Nano-technology for materials or surface science, e.g. nano-composites
B82Y 35/00 Methods or apparatus for measurement or analysis of nano-structures
B82Y 40/00 Manufacture or treatment of nano-structures
B82Y 99/00 Subject matter not provided for in other groups of this subclass

KEYWORDS:

nanoparticle, nanowire, nanostructure, nanotube, nanorod, nanopillar, nanochannel, nanobiotechnology, nanosensor, nano-optic, nanomagnetism, nanoarray, nanometric, nm,…..

NANO+

Problem: Graphene, CNT, micelle, aggregate, …..

Patent Applications Searching:

1.- Databases: INVENES, ESPACENET, PATSTAT, OECD patent database

2.- Classification:B82B, B82Y
- IPC
- CPC

3.- Keywords: NANO+
- IN TITLE
- IN TITLE AND SUMMARY

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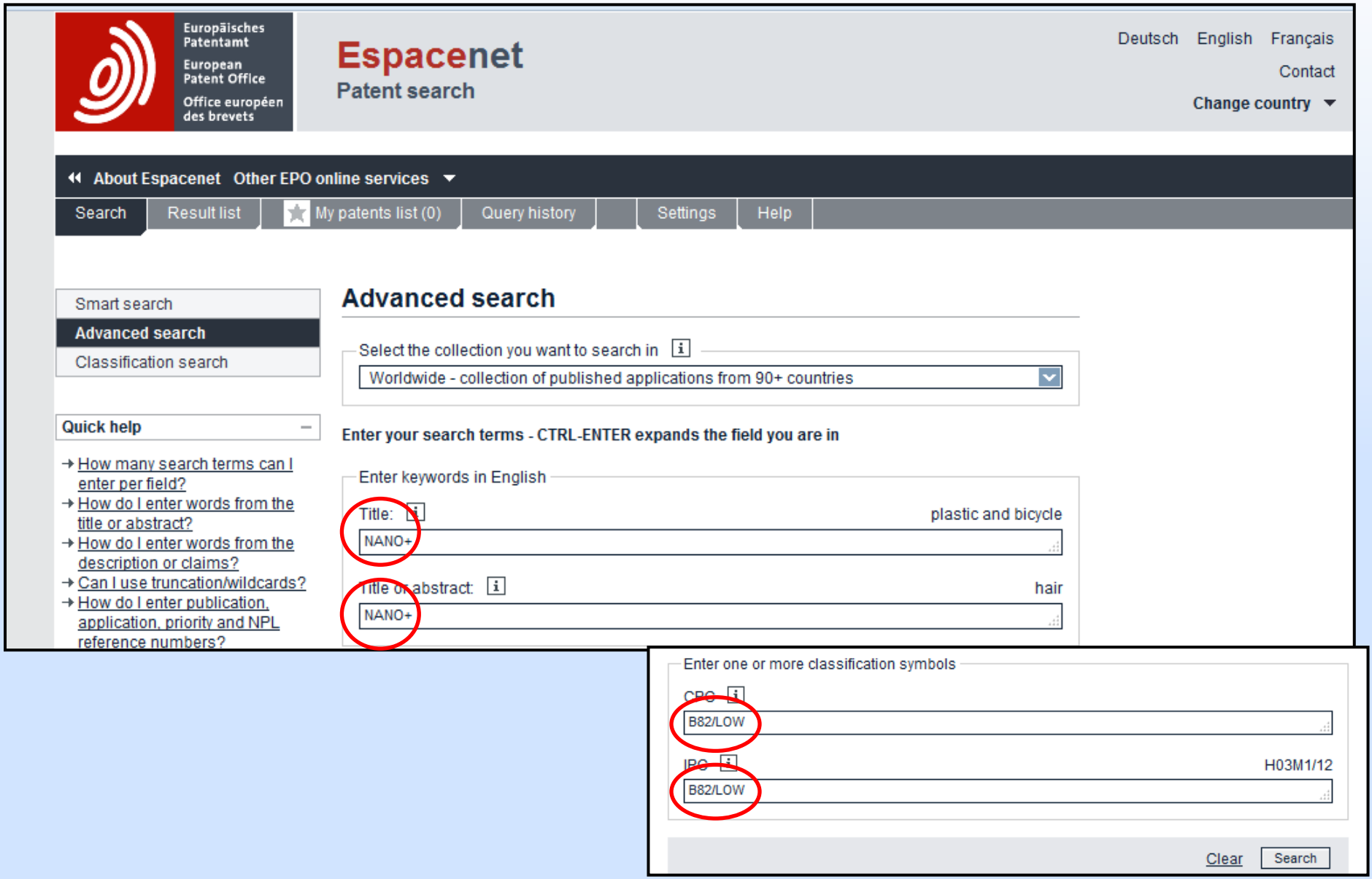

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INVENES

- PRODUCCION V3.0.1.9

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Búsquedas

Opciones

- Abrir Base
- Dominios INTERPAT
- Imprimir Histórico
- Búsqueda Experta
- Búsqueda Simple

Favoritos

- ESP@CENET-LP
- PATENTSCOPE
- ESP@CENET-EP
- BOPI

Formulario de Búsqueda (INTERPAT)

Búsqueda en título:	NANO+	Ej. Motor
Búsqueda en título o resumen:	NANO+	Ej. Bicicleta
Números de publicación:		Ej. ES2118772
Número de solicitud:	P+ OR PCT/ES+	Ej. P200302005 , Ej. U200302008
Número de prioridad:		Ej. US20090510740
Fechas de publicación:		Ej. 20061016
Solicitante/s:		Ej. Roncero
Inventor/es:		Ej. García
Clasificación:	B82+	Ej. A01K1/035

BUSCAR LIMPIAR

Histórico de Consultas

LISTAR
BORRAR
EXPANDIR

Patent applications classified by the SPTO

50%

<50%

DATABASE		B82+ (IPC)	B82+(CPC)	nano+/ti	nano+/tire	B82+ AND nano+/ti	B82+ AND nano+/tire
INVENES	P	251		242	426	115	164
INVENES	PCT	183		178	281	96	121
ESPACENET		63787		>100000	>100000	31032	39731
ESPACENET			>100000			40267	56133

Patent applications classified by all patent offices (IPC)

Patent applications classified by the EPO, USPTO and other offices (CPC)

ARE ALL NANO-TECH PATENT DOCUMENTS CLASSIFIED IN B82 ?

CPC → YES

IPC → NO

Attention: not all patent documents have CPC!!

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PATSTAT. WORLDWIDE

MATERIALS

MEDICAL/BIO

MAIN CLASSIFICATION

SECONDARY CLASSIFICATION

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PATSTAT. SPAIN

Chart explanation:

- These charts provides information about the classifications that the retrieved patent documents have

- The largest areas belong to:
  - B82 class (nanotechnology class)
  - Section A: mainly A61K, A61N and A61P (“nanomedicine”)
  - Section C: mainly C01B, C08K, C09D (“nanomaterials”)

- If **all** nanotech patent documents were **classified in B82** then **A plus C areas** would be **equal to B82 area** but this is not the case

- There are also other classes related to uses

PROBLEMS WITH NANOTECHNOLOGY

Classification: B82B, B82Y not frequently used
B82Y is secondary classification

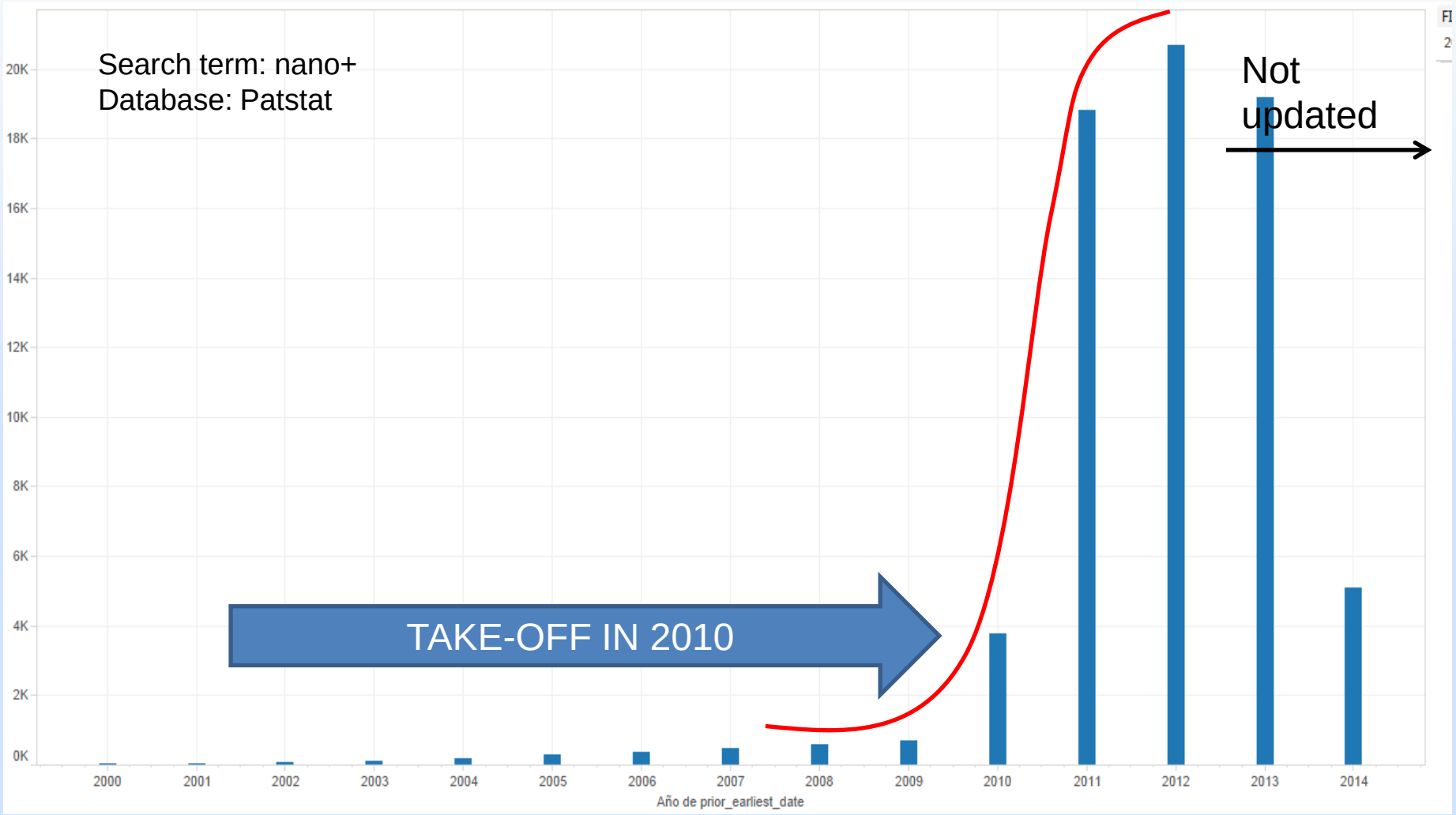
Keywords:

Nano+ searching could provide: too much noise (Ex. NaNO3,…)
too many results

Too many “nano+” synonyms: graphene, CNT, SWCNT,….

Sometimes the nano+ is not in title neither in abstract

PATENT APPLICATIONS. WORLDWIDE



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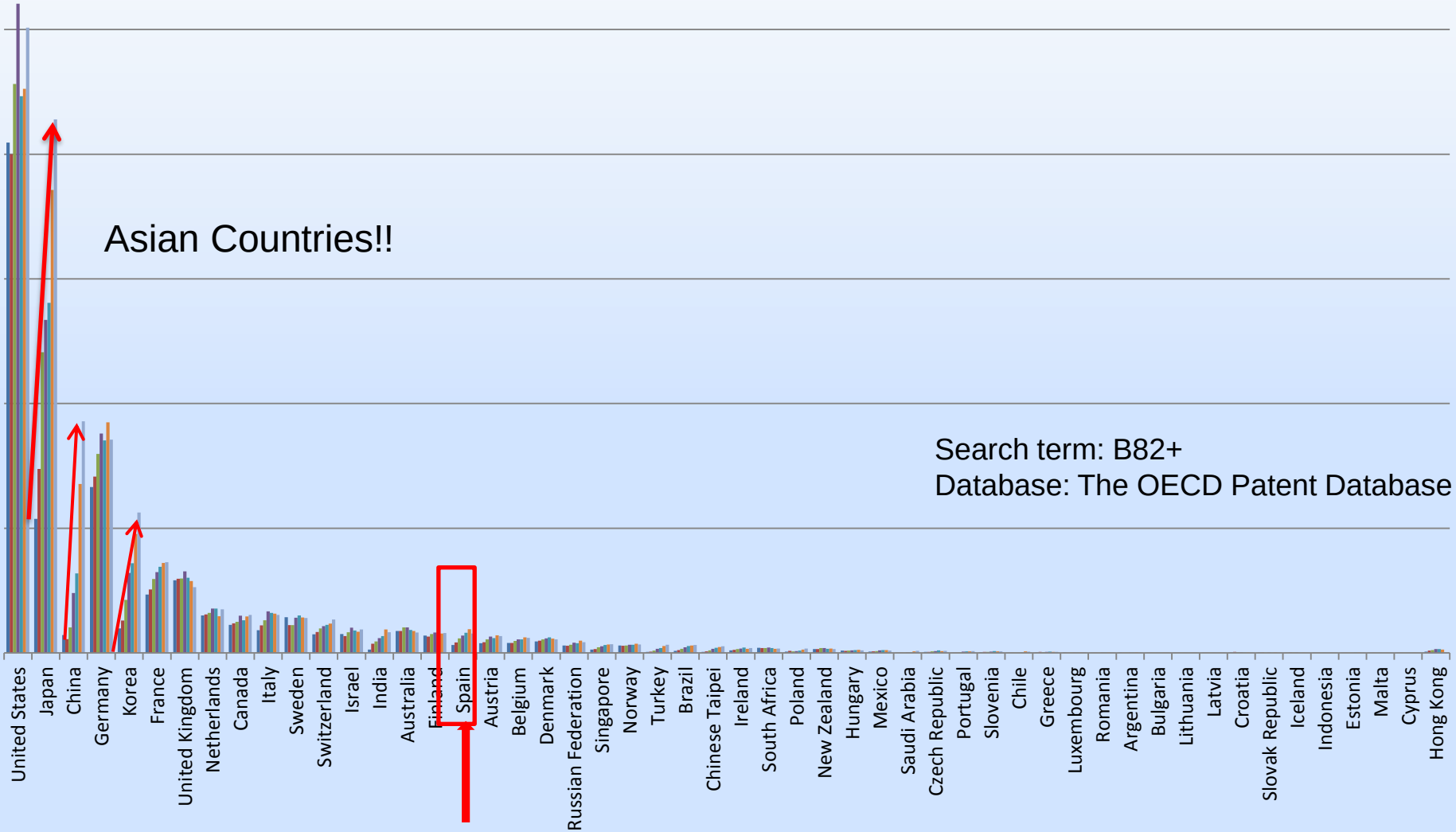
RANKING OF COUNTRIES

Patent applications filed under PCT (2000-2012)



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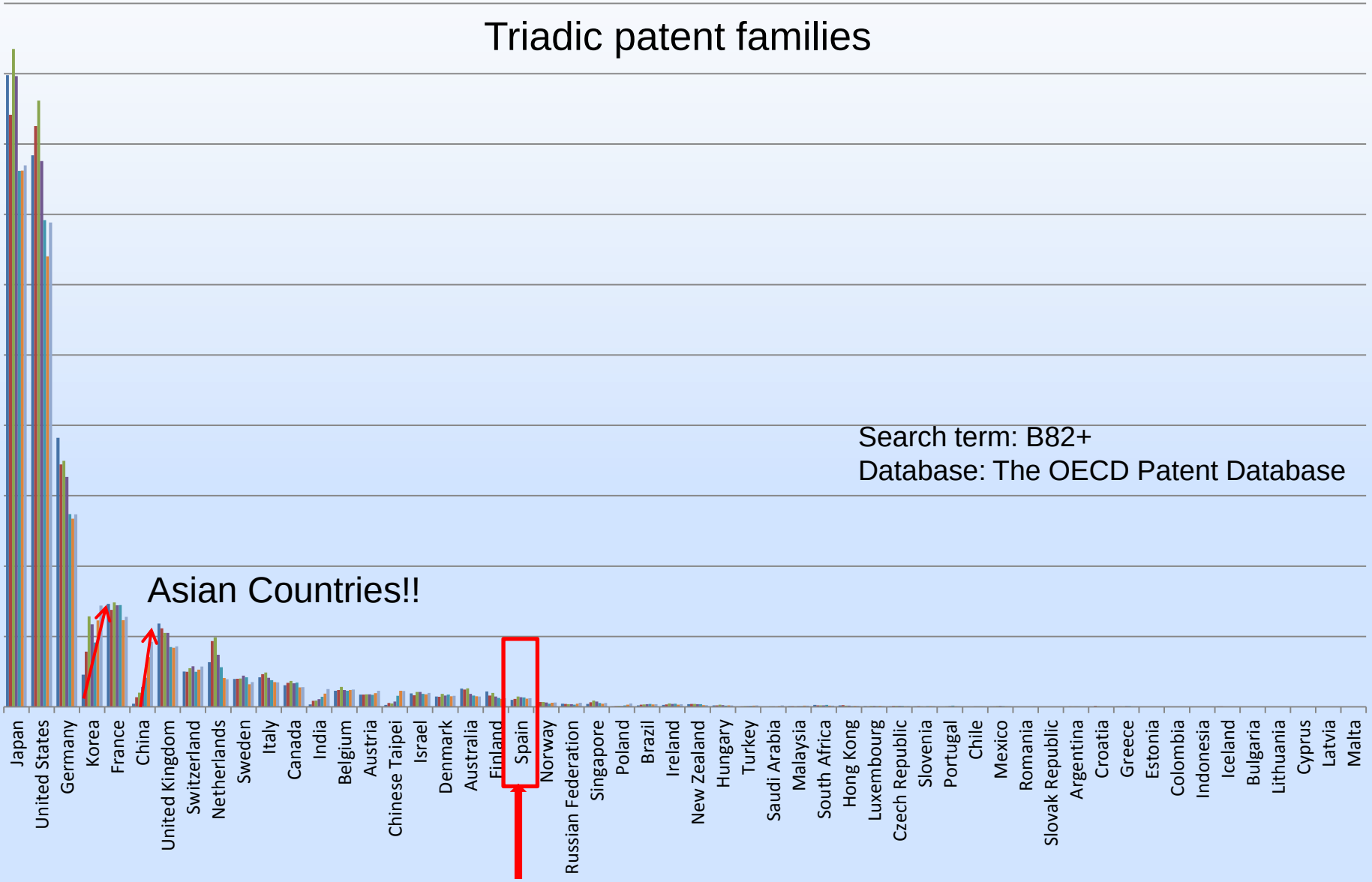
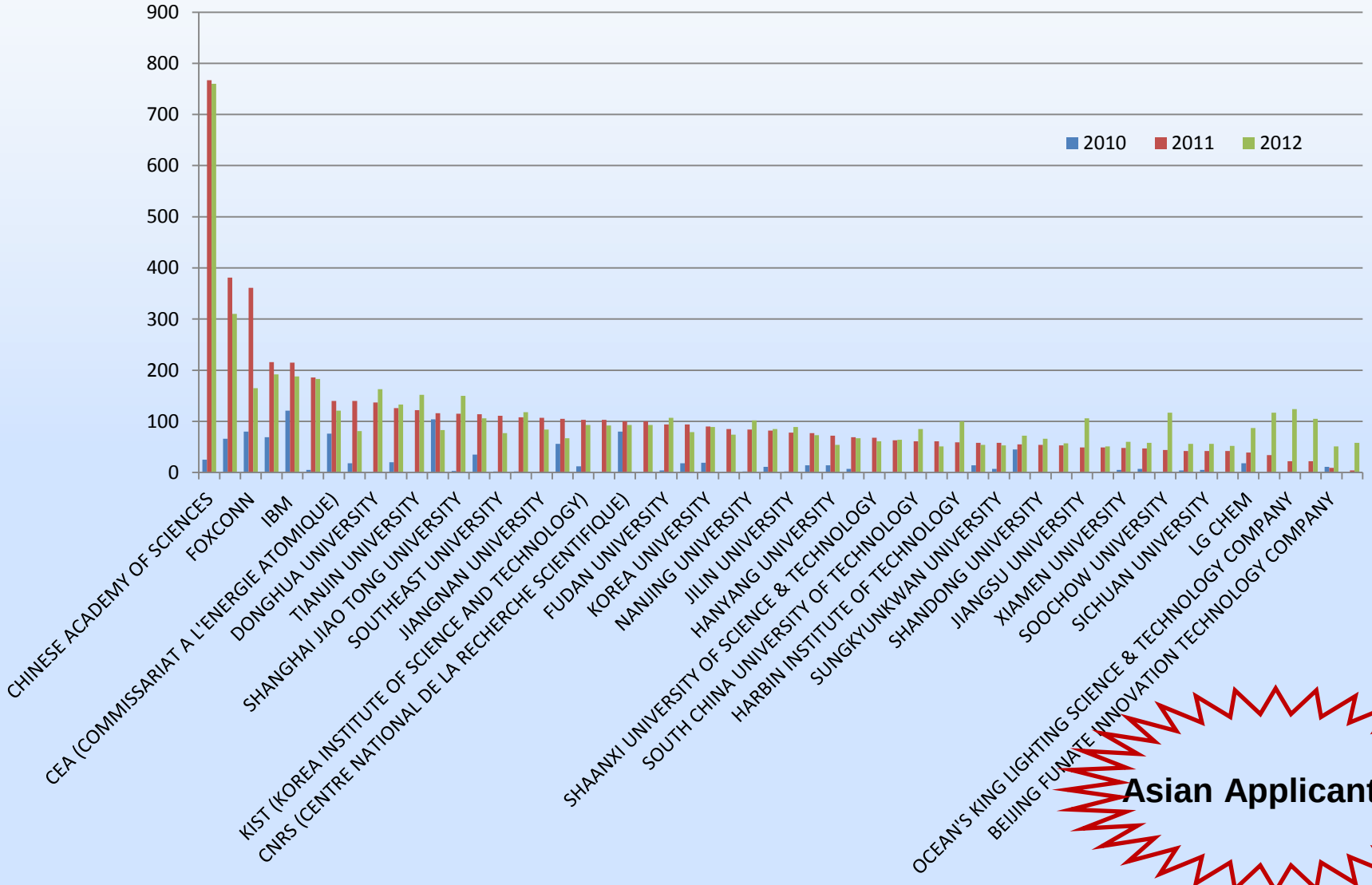
RANKING OF COUNTRIES



RANKING OF APPLICANTS



Asian Applicants!!!!

PATENTING TRENDS IN THE WORLD:

- In 2010, nanotechnology patents applications took off, mainly due to the Asian Countries

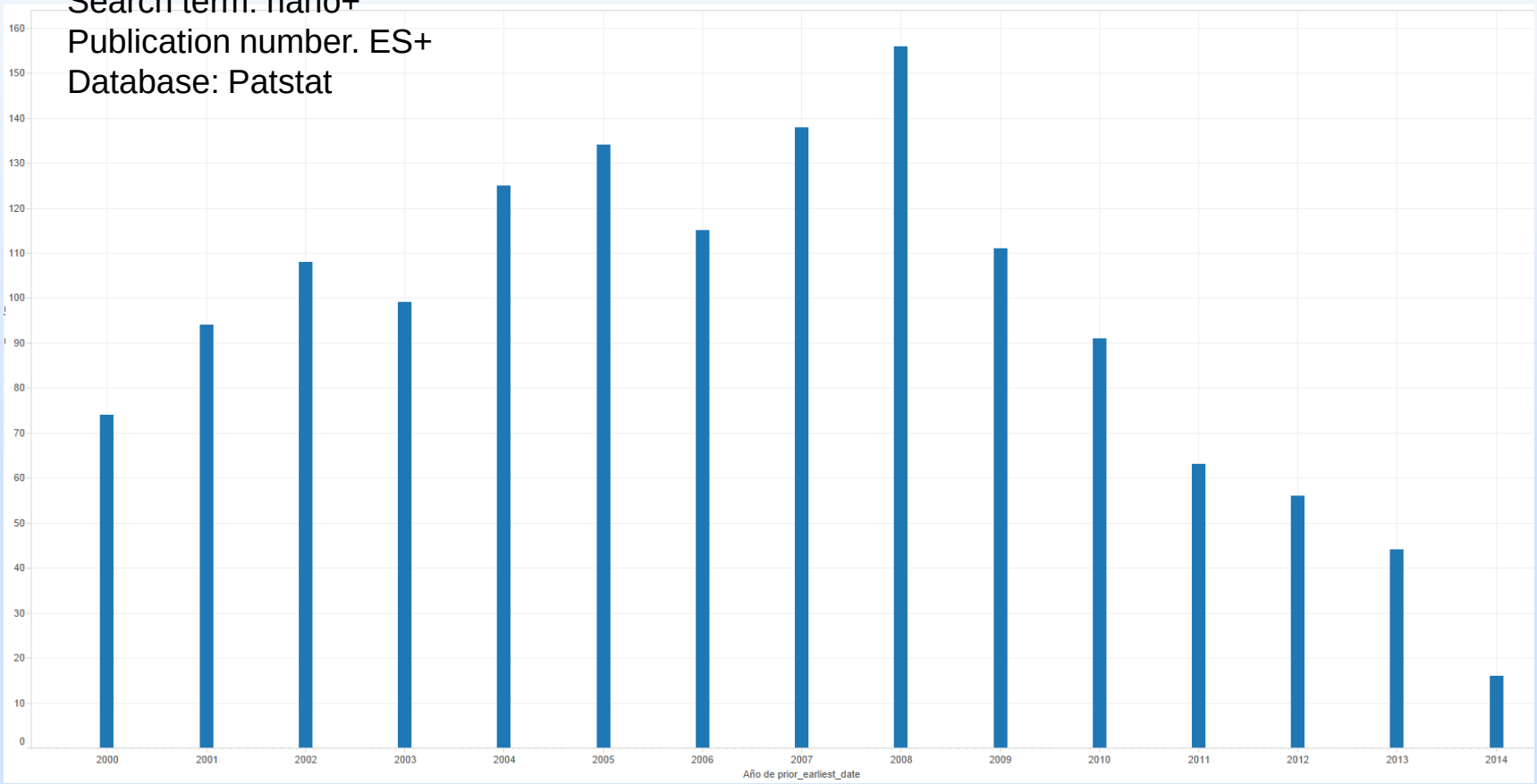
- Main actors: USA, European Countries, Asian Countries

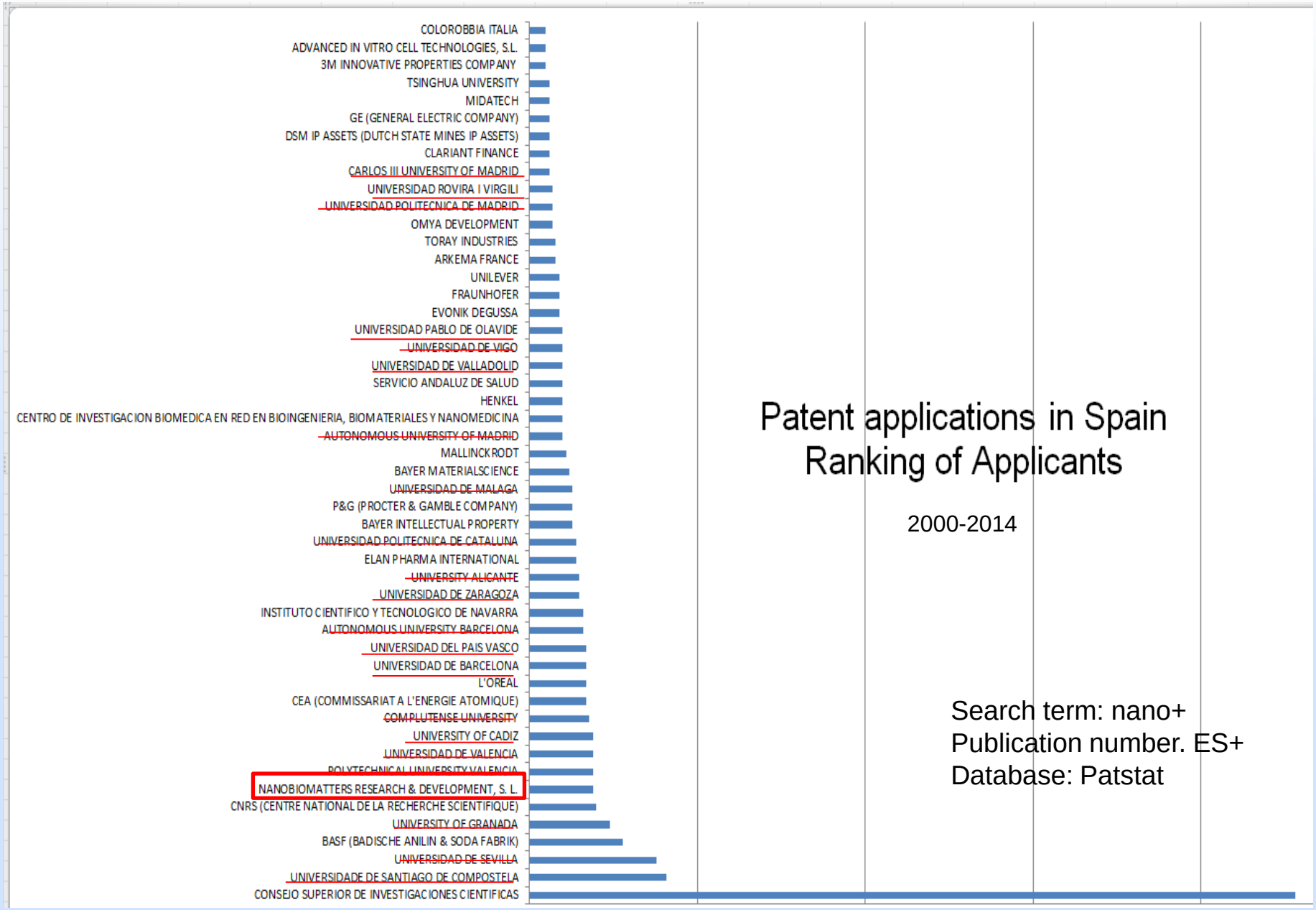
- Top 20 applicants: Asian Applicants (private and universities), IBM, CNRS and CEA (French public institutes)

- Too many patent documents written in Asian languages

PATENT APPLICATIONS. SPAIN

Search term: nano+
Publication number. ES+
Database: Patstat



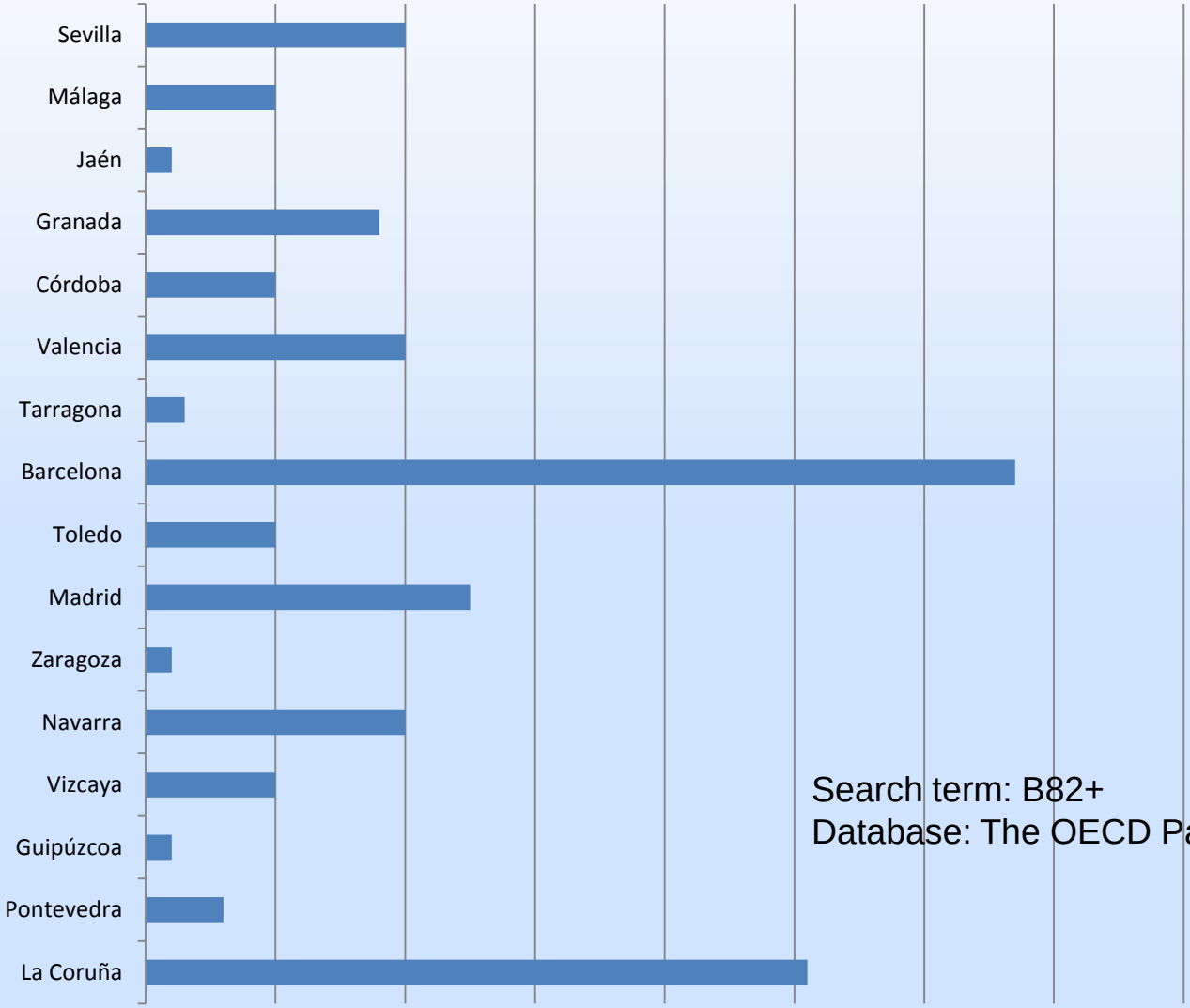


Patent applications in Spain
Ranking of Applicants

2000-2014

Search term: nano+
Publication number. ES+
Database: Patstat

Patent applications filed under PCT in 2011



Search term: B82+
Database: The OECD Patent Database

PATENTING TRENDS IN SPAIN:

- In the top 20 of applicant countries: PCT, and triadic patent applications
- The number of patent applications holds steady since 2000
- Main actors: CSIC and Universities, and 1 SME
- Main cities: Barcelona, La Coruña, Madrid

Why is difficult to Search Nanotechnology in the State of the Art?

- B82+ is not always used
- Too many “nano+ synonyms”
- Too many patent documents written “only” in Asian languages
  (Since 2010 the number of Asian patent applications is quickly increasing)
- Too many uses

Advantages of the patenting scene in Spain:

- Applicants with experience in filing patent applications: main actors are CSIC and Universities

- Inventions well-disclosed: inventors are usually researchers used to write papers

- Well-defined fields: few applicants and with well-established areas of research

Oficina Española de Patentes y Marcas (OEPM)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Examination practice in the field of nanotechnology

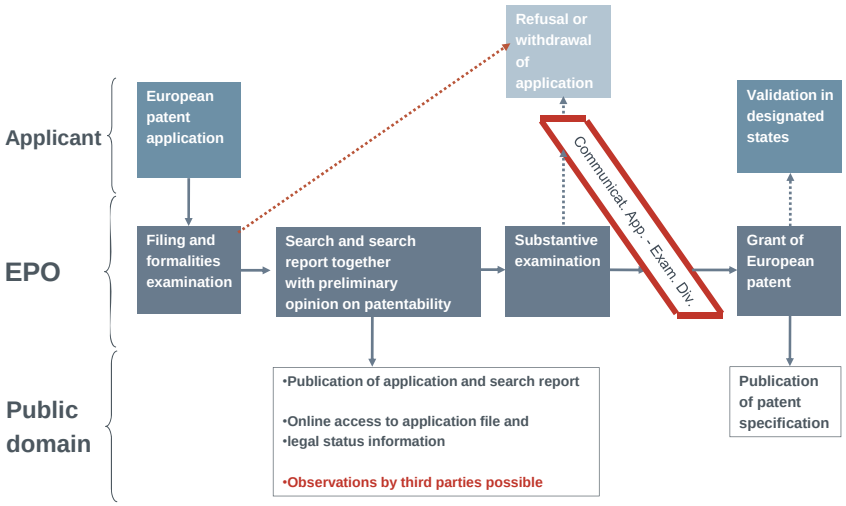
Birgit Lewis, Victor Veefkind

Madrid, 28 October 2015

Agenda

- Overview of European procedure
- Specific Nanotechnology issues
- Conclusions

Overview of the European patent grant procedure



Does the EPO treat nanotech applications differently from other applications?

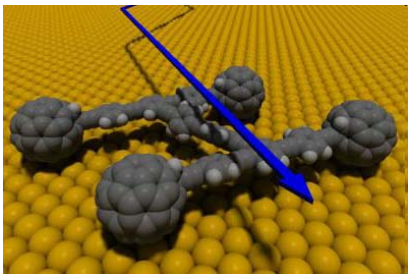
No!

But there are some issues which are more prominent with nanotech applications:

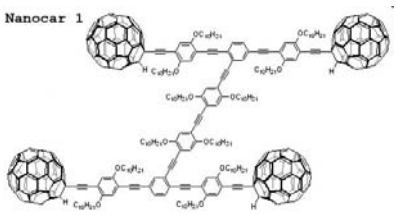
Important in Nanotechnology applications

- Terminology → Clarity (/novelty)
- Enablement → Sufficiency of disclosure
- Selection of (sub-)ranges → Novelty
- Miniaturisation → Inventive step

Category of claims



Source: Rice University, Houston



Apparatus or Substance ?

Clarity

- Often an issue with nanotechnology applications.
- "Nano" has no generally accepted definition, for which the skilled person would unambiguously know the scope.
- Such claim may be unclear (Art. 84 EPC)!
- Applicant may have to specify what he understands to be "nano" in the claims!
  - There needs to be a fallback in the description, defining "nano"!
- Sometimes the same can lead to a novelty objection, i.e. by interpreting the claim broadly, prior art may be novelty destroying, which forces an applicant to restrict or better define the claim.

Novelty: an example

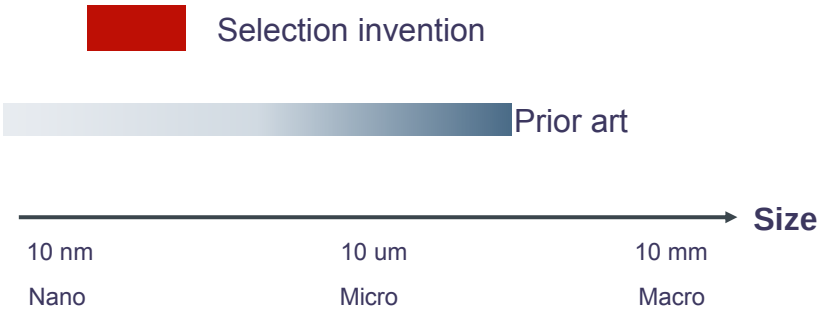
Claim 1:
"A catalyst comprising:
- a honeycomb support structure
- a coating comprising:
  - alumina particles
  - titanium dioxide particles

characterised in that the titanium oxide particles have a size between 10 and 100 nm as measured by SEM."

- Prior art claim:
  - honeycomb with coating of alumina particles and titanium oxide particles of up to 100 micron.

New?

Selection invention



Novelty: selection invention (1)

A sub-range selected from a broader numerical range of the prior art is considered novel, if each of the following three criteria is satisfied (Guidelines G-VI,8)):

(a) the selected sub-range is narrow compared to the known range;
(b) the selected sub-range is sufficiently far removed from any specific examples disclosed in the prior art and from the end-points of the known range;
(c) the selected range is not an arbitrary specimen of the prior art, i.e. not a mere embodiment of the prior art, but another invention (purposive selection, new technical teaching).

An effect occurring only in the claimed sub-range cannot in itself confer novelty on that sub-range. However, such a technical effect occurring in the selected sub-range, but not in the whole of the known range, can confirm that criterion (c) is met, i.e. that the invention is novel and not merely a specimen of the prior art

Inventive step in nanotechnology

- Two particular issues are especially relevant for nanotechnology:
  - interdisciplinarity
  - miniaturisation

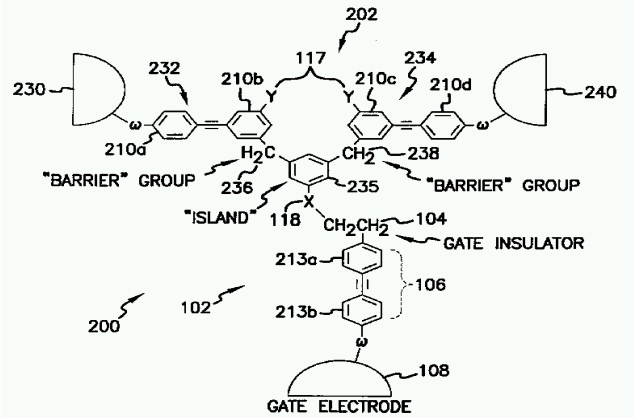
Inventive step – Art. 56 EPC

- Problem/solution approach:
  - What is the closest prior art?
  - What is the difference with this prior art?
  - What is the effect of this difference?
  - What is the (objective) problem to be solved?
  - Would the skilled person apply the solution given in the application in order to solve this problem?

  - No? → Inventive step present
  - Yes? → lacks inventive step.

Interdisciplinary

Chemistry or Electronics?

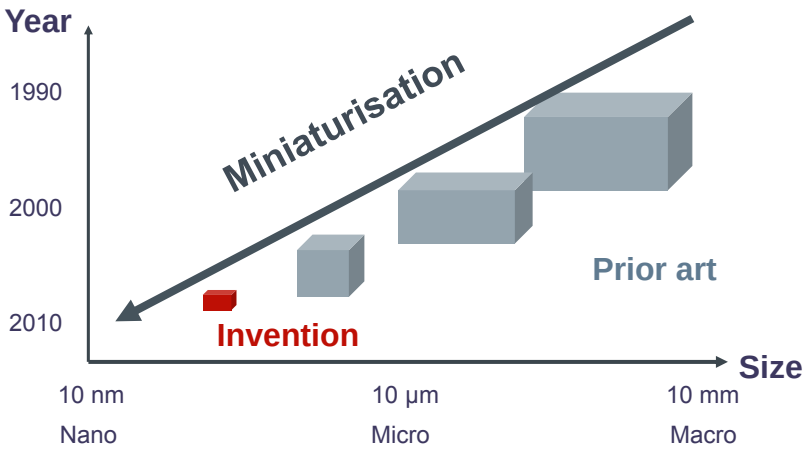


SINGLE MOLECULE TRANSISTOR

So who is the "skilled person"?

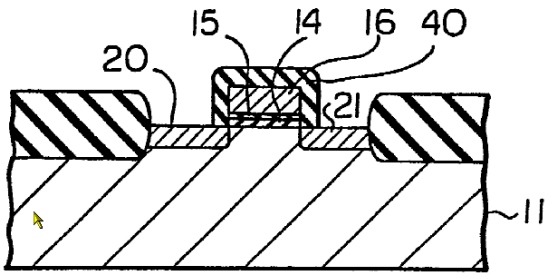
- Would the skilled person apply the solution given in the application in order to solve this problem?
- Chemist or electronic engineer?
- Sometimes the "skilled person" may be a group of people, such as a research team (Case law)

Inventive step



T 610/89: Field effect transistor

Claim:
A field-effect transistor comprising an insulating layer having a thickness in the range of 3 to 18 nm.



"Not inventive"

Reasons for the decision:

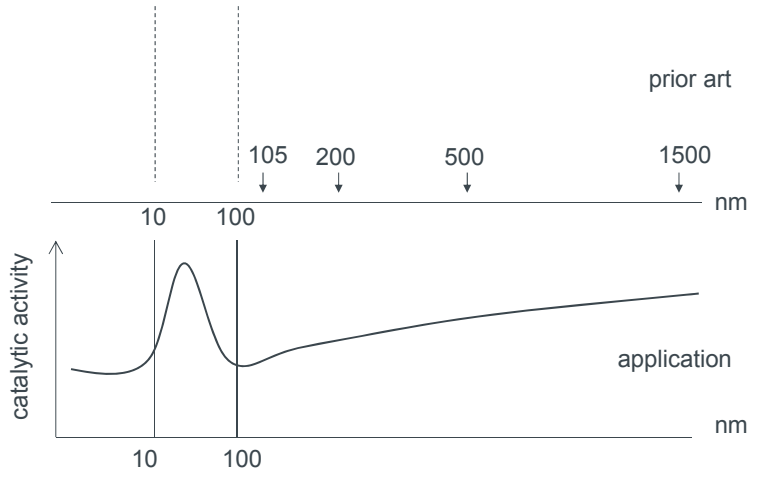
Thickness range of 3 to 18 nm represents a development within a normal trend towards more miniaturisation in semiconductor devices.

No specific effects have been demonstrated.

Thickness range is therefore to be regarded as an arbitrary selection

Summary:
The simple fact of miniaturizing a device without the presence of an additional or surprising effect has no inventive merit.

Inventive step

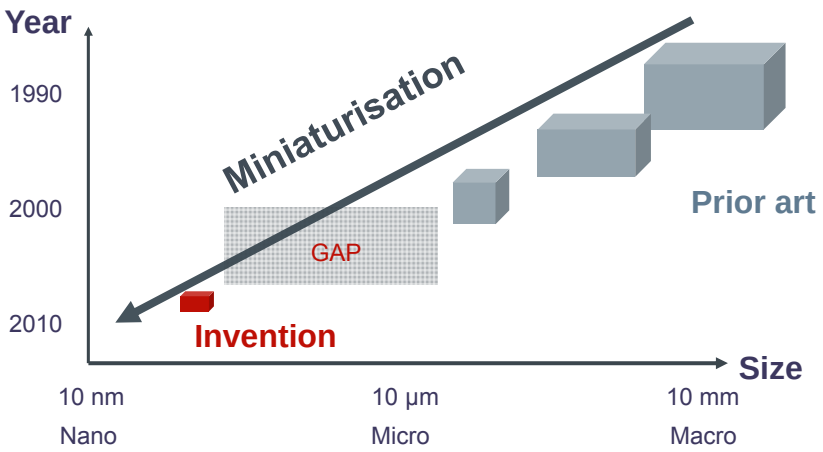


Inventive!

Consequences

- Applicant cannot merely rely on size:
- There needs to be a surprising effect!

Disclosure



- **Disclosure** (Art. 83 EPC):
  - Skilled person at the time of filing must be able to carry out the invention:
- **Consequences**:
  - Beware of prophetic applications with speculative claims! (see for example T184/93)
  - Practical examples or at least textbook knowledge which may give the relevant technical teachings are normally necessary.

Conclusions

- Nanotechnology applications are not examined differently from any other applications.
- There are several issues which play a more prominent role in nanotechnology applications:
  - clarity of terms
  - parameters
  - selection inventions
  - inventive step of miniaturisation
  - disclosure, knowledge and ability of skilled person
- Size **may** matter, especially if it gives rise to an unexpected effect!

Thank you for your attention!

Questions?

Examination Practice at the OEPM in the Field of Nanotechnology

Mª Mar García Poza
Verónica Balmaseda

Madrid, 28 October 2015

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Y TURISMO

Oficina Española
de Patentes y Marcas

Agenda.

- Overview: Spanish Procedure.
- Formalities and Technical Examination.
- Search: Patent and Non Patent Literature.
- Written Opinion.
- Substantive Examination.
- Conclusions

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Spanish Procedure

Formalities and Technical Examination

Formalities Examination

- Request for grant
- Designation of inventor
- Priority data
- Abstract

Technical Examination

- Industrial Application
- Unity of Invention
- Claims supported by the description
- Clarity of claims

Searches in Patent Literature

TOOLS

- Classification
- Keywords
- Cited/Citing Patents
- etc.

CPC

- Nanotechnology: B82Y (B82B sometimes)

DATA BASES

- ESPACENET
- EPOQUE
- WPI
- TXP(...)

Searches in Patent Literature

CPC **COOPERATIVE PATENT CLASSIFICATION**

B82Y **SPECIFIC USES OR APPLICATIONS OF NANO-STRUCTURES; MEASUREMENT OR ANALYSIS OF NANO-STRUCTURES; MANUFACTURE OR TREATMENT OF NANO-STRUCTURES**

NOTES

1. This subclass covers applications and aspects of nano-structures which are produced by any method, and is not restricted to those that are formed by manipulation of individual atoms or molecules.
2. Attention is drawn to the Note following the title of class B82, which defines the meaning of the terms "nano-size", "nano-scale" and "nano-structure" in this subclass.
3. This subclass is intended to enable a comprehensive search of subject matter related to nano-structures by combination of classification symbols of this subclass with classification symbols from other subclasses. Therefore this subclass covers aspects of nano-structures that might also be entirely or partially covered elsewhere in the IPC.
4. This subclass is for secondary classification, i.e. obligatory supplementary classification of subject matter already classified as such in other classification places, e.g.:

B82B	Nanostructures formed by individual manipulation of atoms, molecules, or limited collections of atoms or molecules as discrete units; manufacture or treatment thereof
A61K 9/51	Nano - capsules for medicinal preparations
B05D 1/20	Langmuir-Blodgett films
C01B 31/02	Carbon nano-structures, e.g. bucky-balls, nanotubes, nanocoils, nano-doughnuts or nano-onions
G01Q	Scanning probe techniques
G02F 1/017	Optical quantum wells or boxes
H01F 10/32	Nano-structured thin magnetic films
H01F 41/30	Molecular beam epitaxy [MBE]
H01L 29/775	Quantum wire FETs

5. The classification symbols of this subclass are not listed first when assigned to patent documents.
6. In this subclass, multi-aspects classification is applied, so that aspects of subject matter that are covered by more than one of its groups should be classified in each of those groups.

B82Y 5/00 **Nano-biotechnology or nano-medicine, e.g. protein engineering or drug delivery**

B82Y 10/00 **Nano-technology for information processing, storage or transmission, e.g. quantum computing or single electron logic**

B82Y 15/00 Nano-technology for interacting, sensing or actuating, e.g. quantum dots as markers in protein assays or molecular motors

B82Y 20/00 Nano-optics, e.g. quantum optics or photonic crystals

B82Y 25/00 Nano-magnetism, e.g. magnetoimpedance, anisotropic magnetoresistance, giant magnetoresistance or tunneling magnetoresistance

B82Y 30/00 Nano-technology for materials or surface science, e.g. nano-composites

B82Y 35/00 Methods or apparatus for measurement or analysis of nano-structures

B82Y 40/00 Manufacture or treatment of nano-structures

B82Y 99/00 Subject matter not provided for in other groups of this subclass

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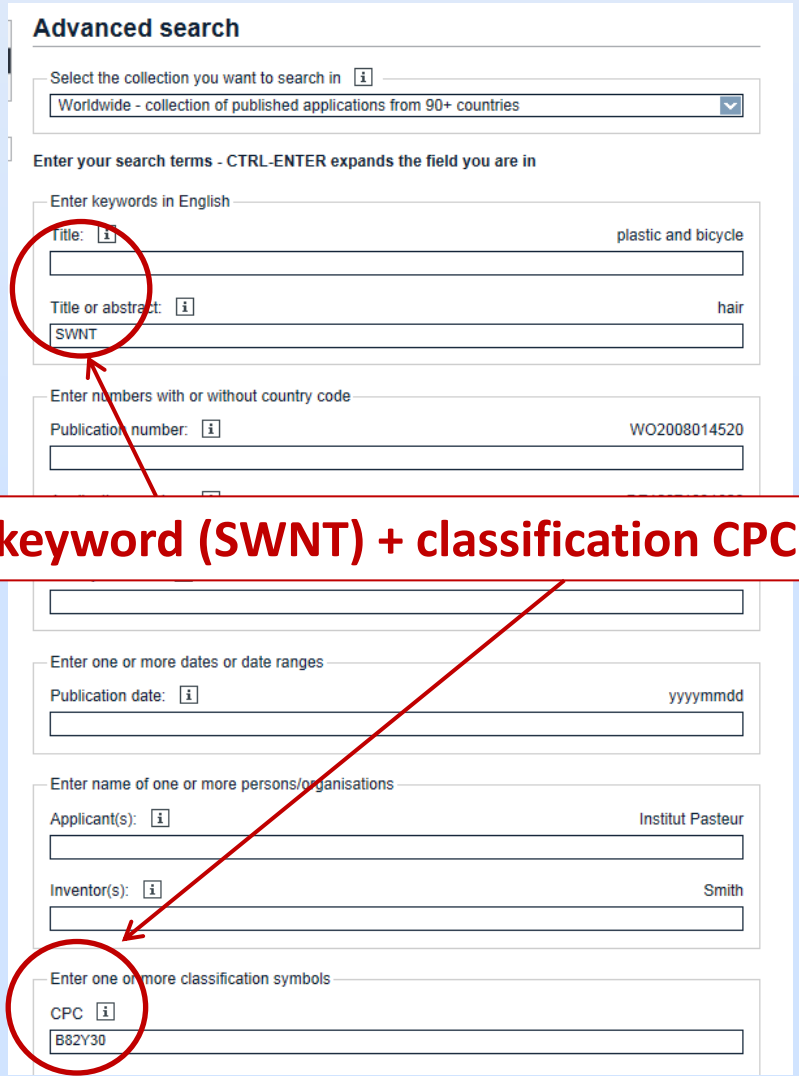
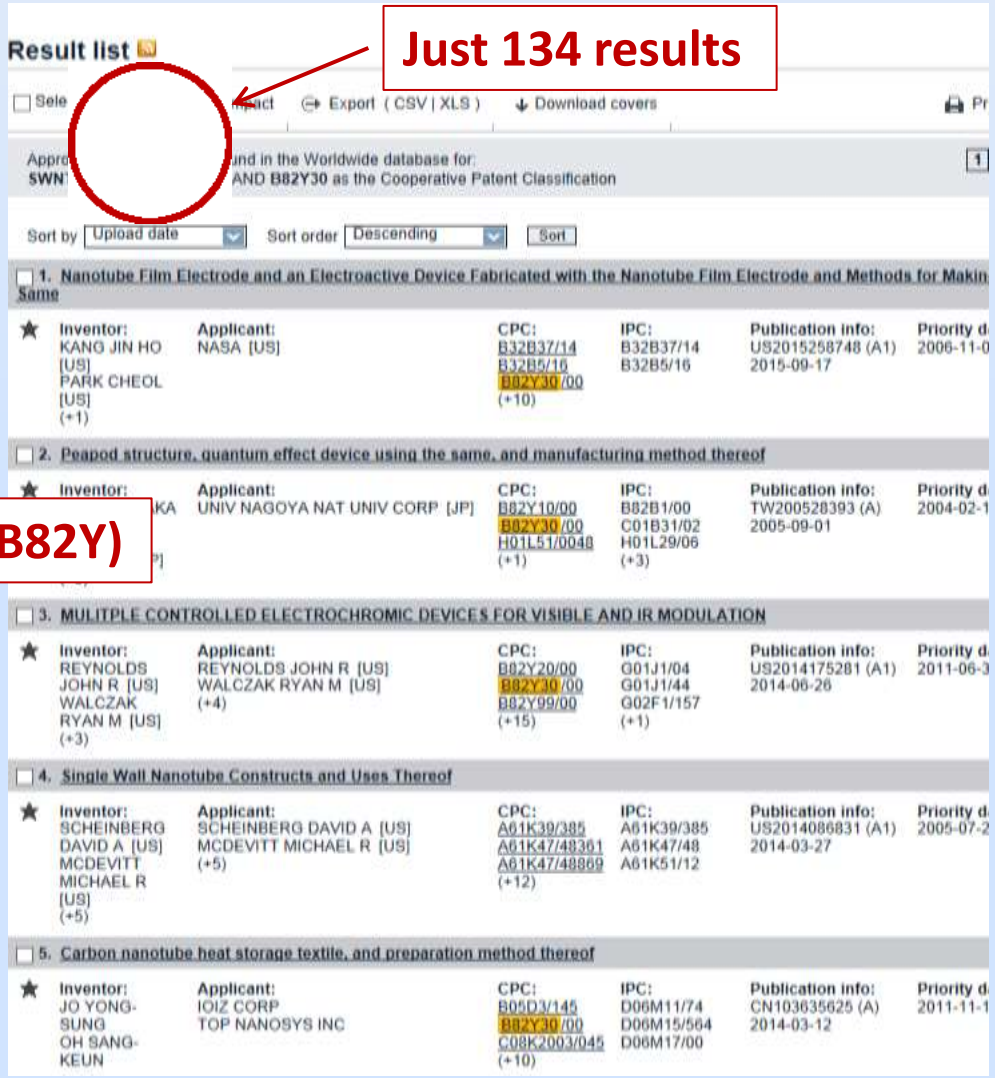
Searches in Patent Literature: espacenet



keyword (SWNT) + classification CPC (B82Y)



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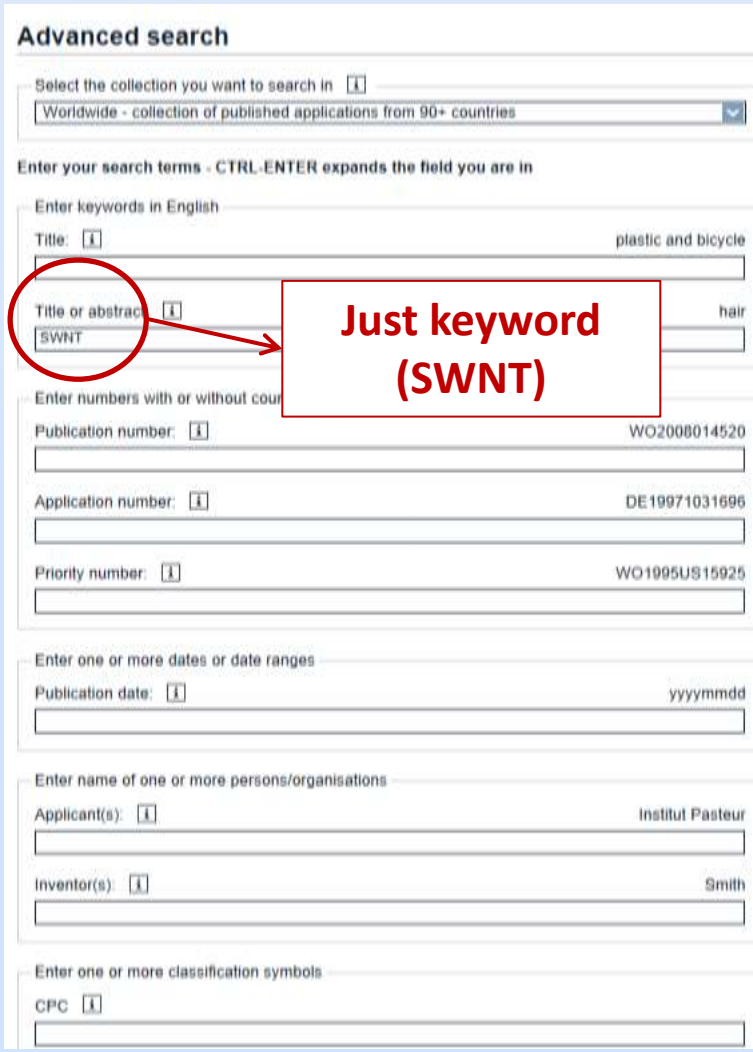
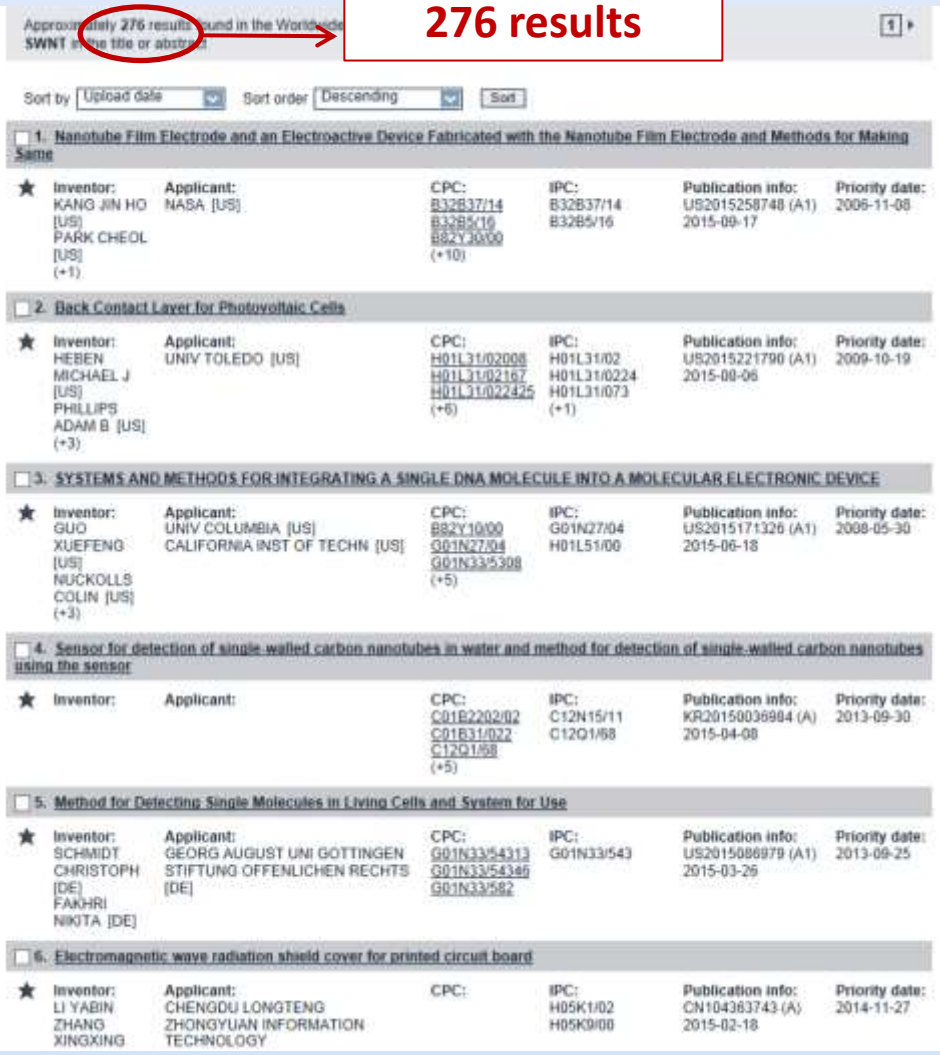
Searches in Patent Literature: espacenet





Searches in Non Patent Literature

EPOQUE DATABASES

- NPL Non Patent Literature
- XPESP Full-text ELSEVIER Publications
- XPOAC Open Access Central Journal
- XPIEE Inst. of Electrical Engineers (IEE)
- XPI3E Inst. of Electrical and Electronic Engineers (IEEE)
- COMPENDEX
- INSPEC
- BIOSIS
- EMBASE
- MEDLINE

STN SEARCH PLATFORM

- CHEMICAL ABSTRACT (CA, HCAPLUS)

INTERNET SEARCHS

- Google Scholar
- IEEE Xplorer
- Sciencedirect

Searches in Non Patent Literature (eg. Google Scholar)

Google SWNT PEM carbon

Scholar About 2,240 results (0.06 sec)

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Particle size and crystallographic orientation controlled electrodeposition of platinum nanoparticles on **carbon nanotubes**
R Sharma, KK Kar - Electrochimica Acta, 2015 - Elsevier
... **Carbon nanotubes** (CNTs) coated with various metallic and non-metallic nanoparticles have ... low operating temperature FCs, such as polymer electrolyte membrane (**PEM**) FCs (PEMFCs ... over the conventional Pt/Pt-alloy nanoparticles supported on **carbon** black electrocatalysts ...
Cited by 4 Related articles All 2 versions Cite Save

Healable, Transparent, Room-Temperature Electronic Sensors Based on **Carbon Nanotube** Network-Coated Polyelectrolyte Multilayers
S Bai, C Sun, H Yan, X Sun, H Zhang, L Luo, X Lei... - Small, 2015 - Wiley Online Library
... Among them, **carbon nanotube** (CNT) films have been widely exploited to act as chemical ... The sensitivity of the healable and transparent FMWCNT3.5/**PEM** film device ... charge-transfer mechanism between p-type semiconductor of multiwalled **carbon nanotubes** (MWCNTs) and ...
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High Aspect Ratio **Carbon Nanotube** Membranes Decorated with Pt Nanoparticle Urchins for Micro Underwater Vehicle Propulsion via H2O2 Decomposition [PDF] from iastate.edu
KM Marr, B Chen, EJ Mootz, J Geder, M Pruessner... - ACS ..., 2015 - ACS Publications
... **Carbon nanotube** (CNT)-templated microfabrication is a new approach to constructing high aspect ratio structures that capitalizes on the very large length to diameter ratios present for **carbon nanotubes**.(24, 25) For modest growth lengths of 1 mm and a nominal 100 nm ...
Cite Save

Polymer Electrolyte Membrane Fuel Cells: Role of **Carbon Nanotubes**/Graphene in Cathode Catalysis
R Sharma, J Cherusseri, KK Kar - Handbook of Polymer Nanocomposites. ..., 2015 - Springer
... Zhang C, Au G, Plichta EJ (2009) Durability study on **SWNT**/nanofiber buckypaper ... Al, Liu Y, Lynam C, Liu H, Wallace GG (2009) **Carbon nanotube** network modified ... activity of platinum/cobalt alloy nanoparticles decorated functionalized multiwalled **carbon nanotubes** for oxygen ...
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Carbon nanotubes grown in situ on **carbon** paper as a microporous layer for proton exchange membrane fuel cells
Z Xie, G Chen, X Yu, M Hou, Z Shao, S Hong... - International Journal of ..., 2015 - Elsevier
... [12] involved the in situ growth of multi-walled **carbon nanotubes** on **carbon** ... 2b, the in situ grown **carbon nanotube** on the **carbon** paper in the PECVD process was multi-wall CNT (MWCNT) with ... Enclosed by the CNT, the nickel particle was isolated from the acidic **PEM** condition ...
Cite Save

MINISTERIO
DE INDUSTRIA, ENERGÍA
Y TURISMO

Oficina Española
de Patentes y Marcas

Written Opinion

Spanish Search Reports will be accompanied by an opinion on whether the application and the invention to which it relates seem to meet the requirements of **novelty** and **inventive step.**

OFICINA ESPAÑOLA DE PATENTES Y MARCAS

ESPAÑA

(11) ES 2 331 640
(21) Nº de solicitud: 200802035
(22) Fecha de presentación de la solicitud: 08.07.2008
(30) Fecha de prioridad:

INFORME SOBRE EL ESTADO DE LA TÉCNICA

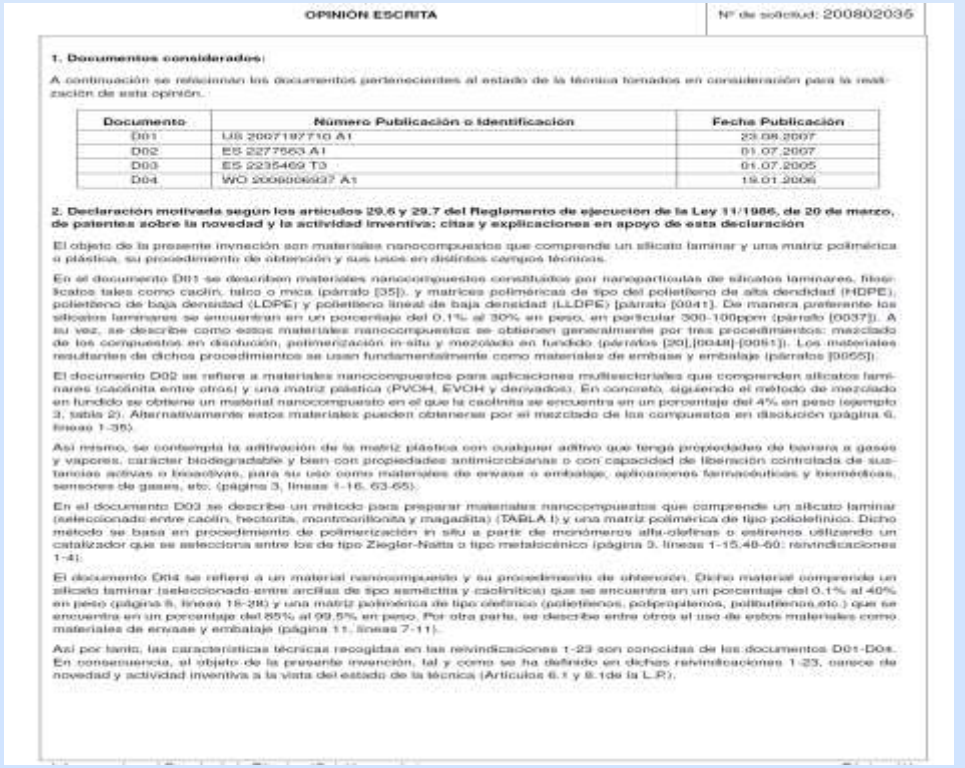
(51) Int. Cl.: Ver hoja adicional

DOCUMENTOS RELEVANTES

Categoría	(56) Documentos citados	Reivindicaciones afectadas
X	US 2007187710 A1 (WU et al.) 23.08.2007, párrafos [0026],[0035],[0037]-[0041],[0046]-[0055]; reivindicación 1,8,39-42.	1-13,16-23
X	ES 2277553 A1 (NANOBIOMATTERS, S.L.) 01.07.2007, página 3, líneas 1-16,36-41,63-65; página 4, líneas 10-45; página 6, líneas 1-35; ejemplo 3; TABLAS 1 y 2.	1-13,16,23
X	ES 2235469 T3 (DOW GLOBAL TECHNOLOGIES INC.) 01.07.2005, página 3 líneas 1-20,48-50; reivindicaciones 1-4; TABLA I.	1-5,7,14, 15
X	WO 2006009937 A1 (AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH) 19.01.2006, página 5, líneas 15-28; página 6, líneas 12-17; página 7, líneas 7-9; página 11, líneas 7-11; reivindicaciones 1-8.	1-8,22,23

Categoría de los documentos citados

X: de particular relevancia
Y: de particular relevancia combinado con otro/s de la misma categoría
A: refleja el estado de la técnica
O: referido a divulgación no escrita
P: publicado entre la fecha de prioridad y la de presentación de la solicitud
E: documento anterior, pero publicado después de la fecha de presentación de la solicitud



OPINIÓN ESCRITA

Nº de solicitud: 200802035

1. Documentos considerados:

A continuación se relacionan los documentos pertenecientes al estado de la técnica tomados en consideración para la realización de esta opinión.

Documento	Número Publicación o Identificación	Fecha Publicación
D01	US 2007187710 A1	23.08.2007
D02	ES 2277553 A1	01.07.2007
D03	ES 2235469 T3	01.07.2005
D04	WO 2006009937 A1	19.01.2006

2. Declaración motivada según los artículos 29.6 y 29.7 del Reglamento de ejecución de la Ley 11/1986, de 20 de marzo, de patentes sobre la novedad y la actividad inventiva; citas y explicaciones en apoyo de esta declaración

El objeto de la presente invención son materiales nanocompuestos que comprende un silicato laminar y una matriz polimérica o plástica, su procedimiento de obtención y sus usos en distintos campos técnicos.

En el documento D01 se describen materiales nanocompuestos constituidos por nanopartículas de silicatos laminares, filosilicatos tales como caolín, talco o mica (párrafo [35]), y matrices poliméricas de tipo del polietileno de alta densidad (HDPE), polietileno de baja densidad (LDPE) y polietileno lineal de baja densidad (LLDPE) (párrafo [0041]. De manera preferente los silicatos laminares se encuentran en un porcentaje del 0.1% al 30% en peso, en particular 300-100ppm (párrafo [0037]). A su vez, se describe como estos materiales nanocompuestos se obtienen generalmente por tres procedimientos: mezclado de los compuestos en disolución, polimerización in-situ y mezclado en fundido (párrafos [30],[0048]-[0051]). Los materiales resultantes de dichos procedimientos se usan fundamentalmente como materiales de embase y embalaje (párrafos [0055]).

El documento D02 se refiere a materiales nanocompuestos para aplicaciones multisectoriales que comprenden silicatos laminares (caolinita entre otros) y una matriz plástica (PVOH, EVOH y derivados). En concreto, siguiendo el método de mezclado en fundido se obtiene un material nanocompuesto en el que la caolinita se encuentra en un porcentaje del 4% en peso (ejemplo 3, table 2). Alternativamente estos materiales pueden obtenerse por el mezclado de los compuestos en disolución (página 6, líneas 1-35).

Así mismo, se contempla la adhesión de la matriz plástica con cualquier aditivo que tenga propiedades de barrera a gases y vapores, carácter biodegradable y bien con propiedades antimicrobianas o con capacidad de liberación controlada de sustancias activas o bioactivas, para su uso como materiales de envase o embalaje, aplicaciones farmacéuticas y biomédicas, sensores de gases, etc. (página 3, líneas 1-16, 63-65).

En el documento D03 se describe un método para preparar materiales nanocompuestos que comprende un silicato laminar (seleccionado entre caolín, hectorita, montmorillonita y magadita) (TABLA I) y una matriz polimérica de tipo poliolefínico. Dicho método se basa en procedimiento de polimerización in situ a partir de monómeros alfa-olefinas o estirenos utilizando un catalizador que se selecciona entre los de tipo Ziegler-Natta o tipo metalocénico (página 3, líneas 1-15,48-60; reivindicaciones 1-4).

El documento D04 se refiere a un material nanocompuesto y su procedimiento de obtención. Dicho material comprende un silicato laminar (seleccionado entre arcillas de tipo esmectita y caolinítica) que se encuentra en un porcentaje del 0.1% al 40% en peso (página 5, líneas 18-28) y una matriz polimérica de tipo olefínico (polietilenos, polipropilenos, polibutilenos,etc.) que se encuentra en un porcentaje del 85% al 99.5% en peso. Por otra parte, se describe entre otros el uso de estos materiales como materiales de envase y embalaje (página 11, líneas 7-11).

Así por tanto, las características técnicas recogidas en las reivindicaciones 1-23 son conocidas de los documentos D01-D04. En consecuencia, el objeto de la presente invención, tal y como se ha definido en dichas reivindicaciones 1-23, carece de novedad y actividad inventiva a la vista del estado de la técnica (Artículos 6.1 y 8.1de la L.P.).

Written Opinion: Novelty in Nanotechnology

"An invention shall be considered to be **new** if it **does not form part of the state of the art**.

The state of the art shall be held to comprise everything made available to the public by means of a written or oral description, by use, or in any other way, before the date of filing of the application."

Written Opinion: Novelty in Nanotechnology

Novelty most frequent defects in nanotechnology field

→ **Broad Claims**

→ **Size Matters**

Novelty in Nanotechnology: Broad Claims

Sometimes claims are formulated in such broad terms that they also cover known subject-matter from other technical fields. In the nanotechnology field, sometimes applicants claim not only the nanoscopic but the macroscopic.

Broad claims may also cover embodiments for which an alleged effect has not been achieved.

Novelty in Nanotechnology: Broad Claims

Claims

1. Nanocomposite materials **characterised in that** they comprise the following components:

    a. matrix;
    b. additives or nanoadditives.

Claims

1. Organic-inorganic matrix which comprises tris(β-diketonate) complex from two cations of different lanthanide elements.

2. Matrix according to claim 1, which also comprises coated nanoparticles.

Claims

1. Stable atomic quantum clusters, AQCs, **characterized in that** they are composed of less than 500 metal (Mn, m>500).

Novelty in Nanotechnology: Size Matters

Size is everything in the world of nanotechnology, but as a general rule, it is not sufficient condition to establish the novelty of an invention, even the slightest overlap is sufficient to destroy novelty.

1. Magnetic nanoparticles of noble metals non-magnetic in the mass state of size less than 5 nm comprising

a) a core formed from a noble metal and

b) an anisotropic crust formed from compounds containing at least one metal-sulphur covalent bond.

DOCUMENT D01

"If the solutions contain, however, various monodisperse fractions of particles very interesting ordering phenomena can be observed [36]. An example of such a case is shown in the TEM micrograph in Fig. 2, which depicts a bimodal AB2 type superlattice of 4.5 and 7.8 nm gold particles stabilised by decanethiol [36]."

Novelty in Nanotehcnology: Size Matters

There must be a new technical effect or this must be extraordinarily enhanced in a selected subrange.

1. A magnetic nanoparticle selected from Au, Pd, Pt and Ag, the nanoparticle having a size between 1.0 and 2.0 nm, comprising:

a) a core formed from a noble metal and

b) an anisotropic crust formed from compounds containing at least one metal-sulphur covalent bond.

In this size subrange noble metal nanoparticles the appearance of ferromagnetic behaviour is observed.

MINISTERIO
DE INDUSTRIA, ENERGÍA
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Written Opinion: Inventive Step in Nanotehcnology

"An invention is considered as involving an **inventive step** if, having regard to the state of the art, it is not obvious to a person skilled in the art."

When assessing whether or not a nanotechnology invention involves an inventive step, the key question is often whether the miniaturization of a known device or the addition of nanoelements or nanostructures is inventive.

Is it just a random selection or is there a new technical advantage to be had from making it smaller ?

There is **no inventive step** when it is just a **mere size reduction or just a simple addition of nanoparticles** without an unexpected effect.

Written Opinion: Inventive Step in Nanotechnology (NOT INVENTIVE EXAMPLES)

MINIATURIZATION

No effect described apart from the size

1. A layered nanoparticle macro-composition, comprising: a nanoparticle inner nucleus, an intermediate layer around the nucleus and an outer layer intercalated with the nucleus or encapsulating the nucleus and the intermediate layer wherein the macro-composition is no more than about 100 nanometers in size.

ADDITION OF NANOTUBES

No effect described just the addition of carbon nanotubes

1. Material cerámico compuesto de nitruro de silicio **caracterizado** porque está constituido por una matriz densa, preferentemente con una densidad mayor de 3 $g \cdot cm^{-3}$, más preferentemente, mayor de 3,1 $g \cdot cm^{-3}$, sin poros de nitruro de silicio (fase continua) y porque comprende nanotubos de carbono (CNTs) (fase reforzante o discontinua) uniformemente dispersos en el seno de dicha matriz y no degradados.

2. Material cerámico según la reivindicación 1 **caracterizado** porque el nanotubo se selecciona del siguiente grupo: nanotubos de pared sencilla, de pared doble y de multipared (SWNTs, DWNTs y MWNTs, respectivamente), y combinaciones de ellos.

MINISTERIO DE INDUSTRIA, ENERGÍA Y TURISMO

Oficina Española de Patentes y Marcas

Written Opinion: Inventive Step in Nanotechnology (INVENTIVE EXAMPLES)

MINIATURIZATION

This size subrange improve their magnetic properties and hence their properties as contrast agent

1. Nanopartículas magnéticas caracterizadas por que comprenden un núcleo de magnetita con bismuto en su superficie, presentan un tamaño comprendido entre 5 nm y 30 nm, incluidos ambos límites, y son de forma octaédrica, cristalinas y monodispersas.

ADDITION OF NANOPARTICLES

Unknwon colour values in zirconia are possible with the addition of diamond nanoparticles.

1. Material compuesto nanoestructurado que comprende al menos circona y nanoparticulas de diamante y presenta una coloración dentro del sistema de colores CIE L*a*b* correspondiente a valores del índice L* comprendidos entre 40 y 98.

Substantive Examination

Sustantive Examination requests, here in Spain, are just 10-12% of patent applications.
In most cases, patentability requirements are met (i.e. there was a positive written opinion) and no other oppositions were raised.

In other cases, when applying for substantive examination, applicants file amended claims fullfiling patententability requirements and therefore the patent is granted.

Substantive Examination

ORIGINAL CLAIMS

Claims

1. Organic-inorganic matrix which comprises tris(β-diketonate) complex from two cations of different lanthanide elements.

2. Matrix according to claim 1, which also comprises coated nanoparticles.

AMENDED CLAIMS

1. Organic-inorganic matrix which comprises tris(β-diketonate) complexes from two cations of different lanthanide elements;
wherein the cations of lanthanide elements are in a trivalent state of oxidation,
wherein the cations are europium (Eu) and terbium (Tb);
wherein the terbium cation presents an excited state $^5D_4$;
wherein the matrix presents an excited state T; and
wherein the energy of the excited state T is such that allows the thermally pushed energy transfer $^5D_4 \rightarrow T$.

Substantive Examination

ORIGINAL CLAIMS

1. Magnetic nanoparticles of noble metals non-magnetic in the mass state of size less than 5 nm comprising

a) a core formed from a noble metal and

b) an anisotropic crust formed from compounds containing at least one metal-sulphur covalent bond.

AMENDED CLAIMS

1. A magnetic nanoparticle selected from Au, Pd, Pt and Ag, the nanoparticle having a size between 1.0 and 2.0 nm, comprising:

a) a core formed from a noble metal and

b) an anisotropic crust formed from compounds containing at least one metal-sulphur covalent bond.

In this size subrange noble metal nanoparticles the appearance of ferromagnetic behaviour is observed.

Conclusions

Patent claims should be written strategically, keeping in mind:

what competitors in the field are doing, what other patents have been granted in the field, etc.

Usually it is good to build a number of fall-back positions into the patent specification.

An independent claim with a broader scope and a number of dependent claims that would narrow the scope but still protect the essentials of the invention.

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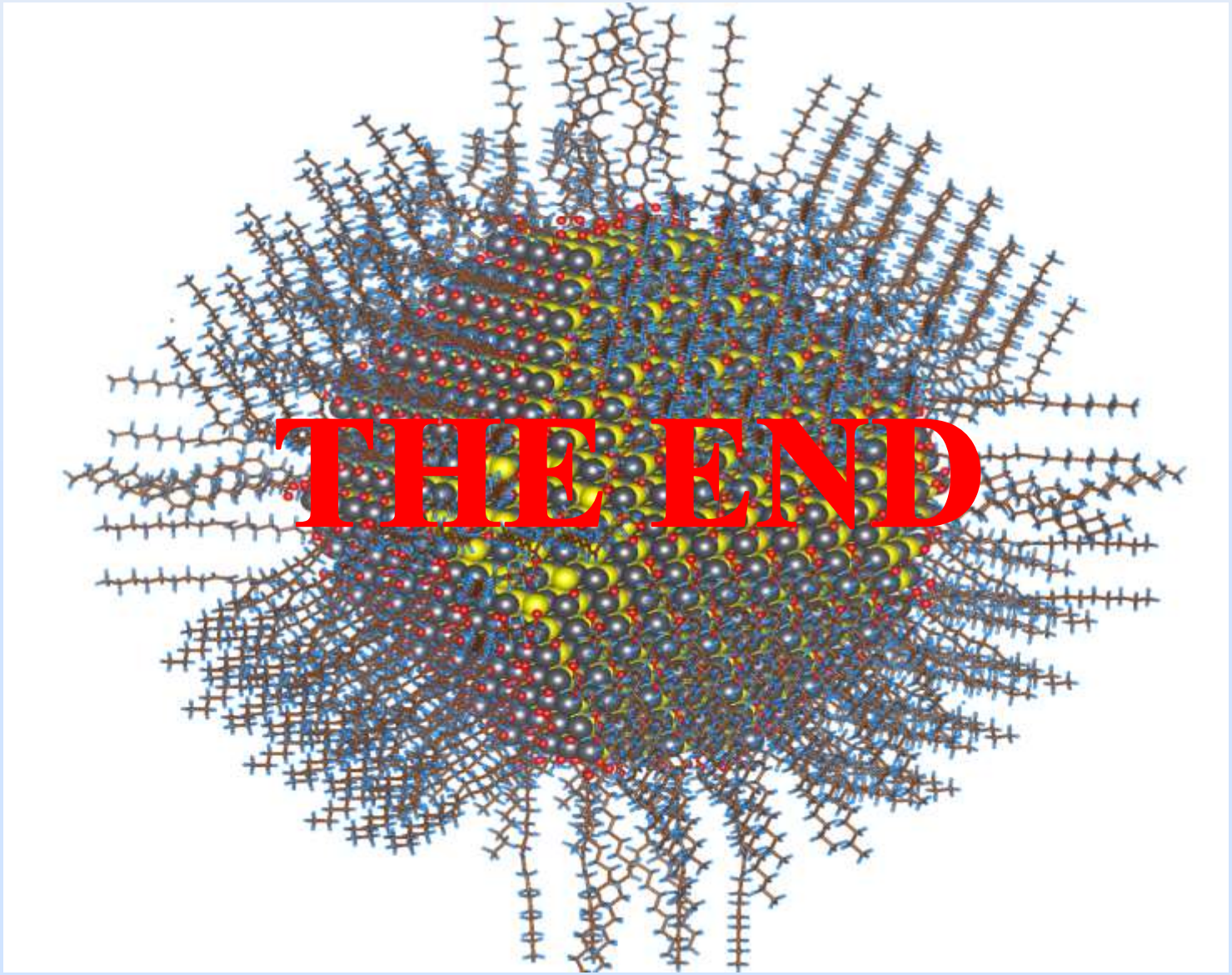
Every relevant feature disclosed in the description must be included within the claims.

Carefully draft claims that are clear and concise, provide proper fall-back positions and include all essential features of the invention.


THE END

Thank for your attention!

Oficina Española de Patentes y Marcas (OEPM)

EXPERIENCE IN PATENTING IN THE FIELD OF NANOTECHNOLOGY

Patenting procedures in the field of nanotechnology. Madrid 2015

REPSOL'S CURRENT VIEW OF NANOTECHNOLOGY

INTEGRATOR to be able to apply achievements in Nanoscience when facing the actual major energy challenges

Change of technological paradigm

- Avoid obsolescence risk in our technical competences.

Game changer and transversal technology

- No incremental advances

Opportunities in applications

- High potencial impact in our activity.

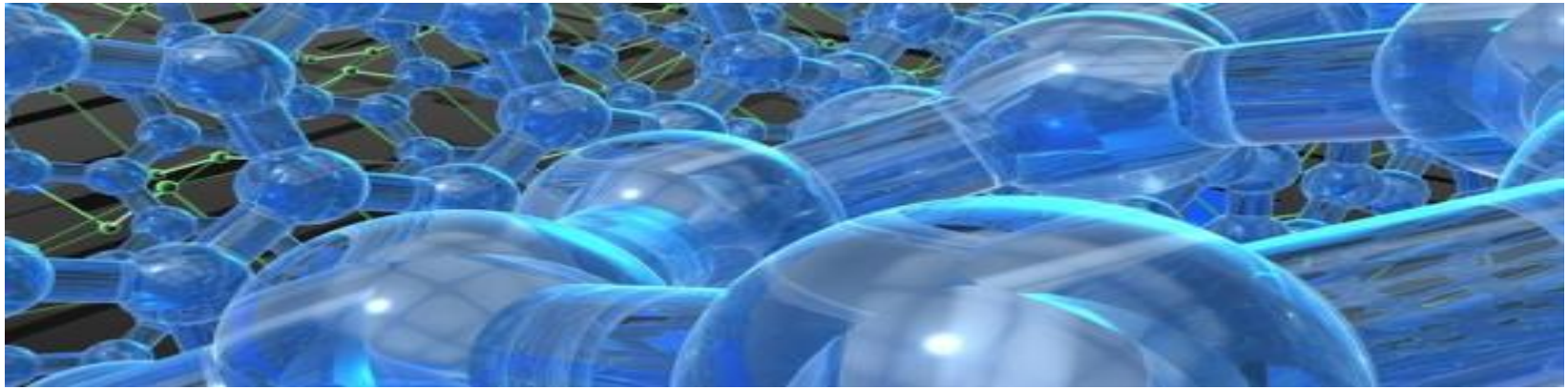
Why Nanotechnology in Repsol

Technology watch Project Results:

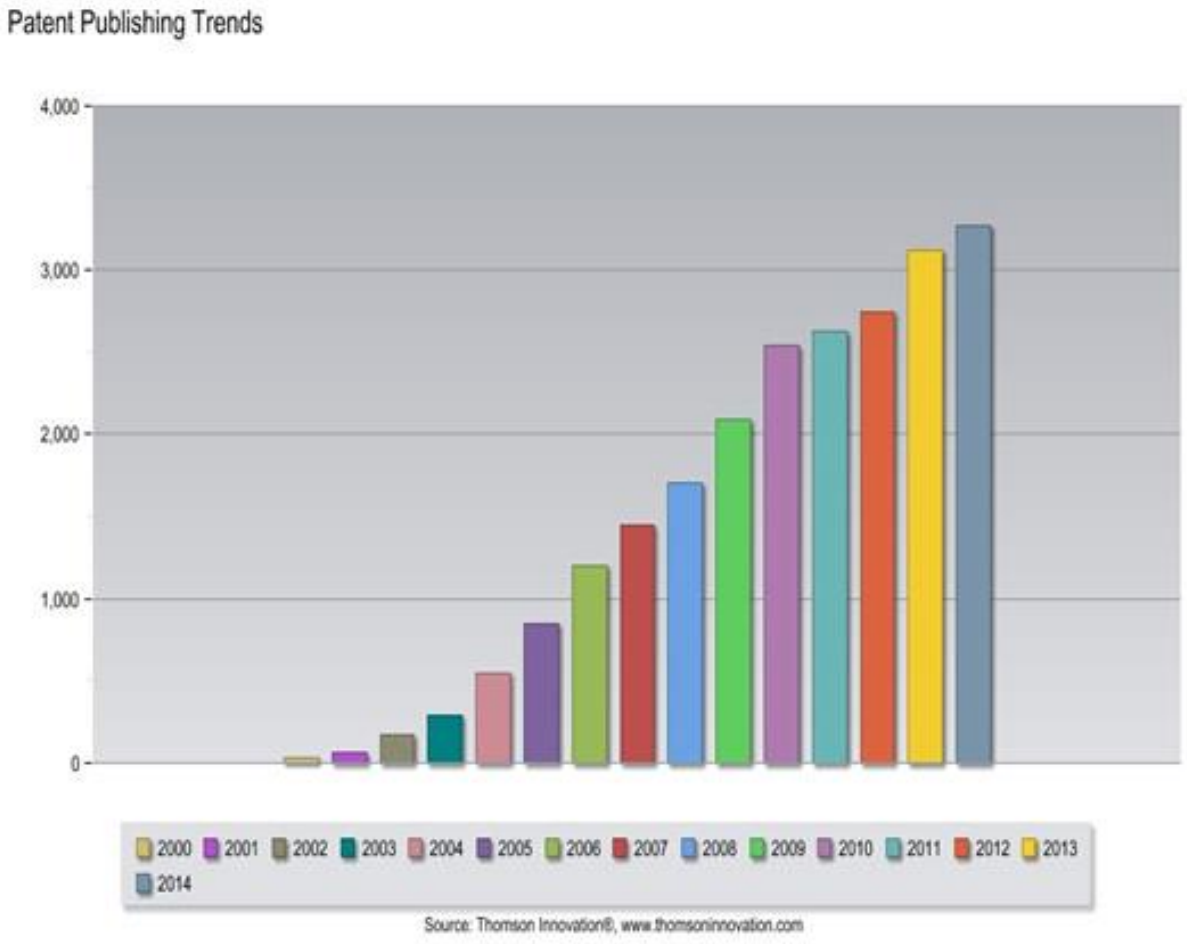
- Nanotechnology can provide solutions of High Impact/High Potencial for some of our Technological challenges.

- Such solutions could be available for Industrial applications in 10 years.

- It is the momment to work in some of those solutions and obtain IP



There are an exponential increase in Nanotechnology Patents



Graphene Project

Year 1: Searching for solutions and proof of concept

- Research of materials with higher potential and manufacture of prototype demostrators.

Year 2: Selection of solutions

- Identification of materials, devices and manufacture procedure that could achieve the technical objectives of the Project with the criteria of **Novelty and Inventive Step**

Year 3: Optimization of solutions

- Material and devices to complete Patents and consolidate technology

How we begin the Process

Significant Invention → Submision to Patent Commitee → Review by the Patent Commitee

Process of filing a Patent application

First, state of the art search (Pat. Agent)

Pat. preparation (Pat. Agent)

Pat. Agent files Patent application at EPO

Pat. Agent prepares reply to ESR

Patent Office exam

Patent

Inventor updates Pat. Agent with modifications

Inventor updates Pat. Agent with modifications

Process for Paper Publication

- After negative Prior State of the Art search
- If Committee rejects filing a Patent Application
- After Filing a Patent Application

Patents

For now we have filed **three** Patents applications at the EPO.

- ✓ First, a study about the relevance of the subject of the patent is made, to decide whether the application goes forward or not.
- ✓ After careful examination together with the Patent Agent, we conclude that the Patents could be presented with high probability of concession
- ✓ In the three Patent applications, it was suggested by the Patent Agent to perform further experiments, to have enough examples to proof all the claims

Patents

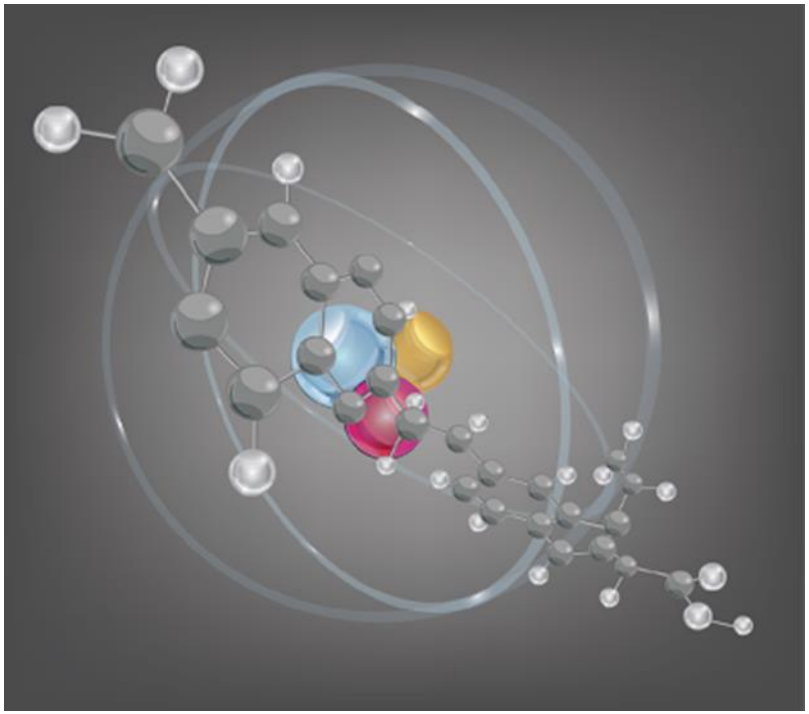
At the moment we have presented three papers related with Graphene applications in batteries and supercapacitors.

We have received now the reply of examiners.

The majority of the documents cited by the examiners, were known by us, and taking into account in the Patents filing

Despite all the previous work in the preparation, we need an extra hard work of **All** the team to answer examiner.

We are confident that we will obtain the three Patents



Conclusions

Based on my experience:

- Even though the exponential increase in Nanotechnology´s Patents it is the moment to obtain IP in Nanotechnology applied to Energy
- In Repsol we are working to obtain IP in relevant applications of Nanotechnology to Energy.
- It is very convenient to have a detailed process and a team of scientists and Patent experts before filing a Patent Application
- For us, the Patent Agent plays a fundamental role in the process, and it is needed that he “puts himself/herself in both Scientist and the Examiner’s shoes”.

REPSOL

Let's invent the future

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Technology transfer in the area of NANOTECHNOLOGY

CSIC

SPANISH NATIONAL RESEARCH COUNCIL

Deputy Vice-presidency for Knowledge Transfer

Dr. Javier Maira Vidal

Head of Commercialization Unit

Brief Introduction to CSIC

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

SPANISH NATIONAL RESEARCH COUNCIL

Largest public research institution in Spain

CSIC centres/ Joint centres

75 **53**

128 Institutes /Centres

CSIC in figures

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

- **14,144 employees: 5,375 scientific researchers**
- **3,923 international and national research projects/actions**
- **379 European projects partnered by CSIC. It is the fourth European institution that received more funding from the European VII Framework Program**
- **12,420 SCI papers (those in ISI and/or SCOPUS journals)**
- **1,012 doctoral thesis**

CSIC in Scimago

CSIC
Consejo Superior de Investigaciones Científicas

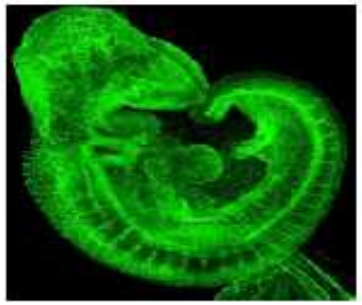
4847 ranked institutions | Download data (csv)

1 (1)	Centre National de la Recherche Scientifique *	FRA		100.00
2 (2)	Chinese Academy of Sciences *	CHN		75.97
3 (3)	Russian Academy of Sciences *	RUS		43.45
4 (4)	Harvard University	USA		37.90
5 (5)	Helmholtz Gemeinschaft *	DEU		31.07
6 (6)	Max Planck Gesellschaft *	DEU		25.29
7 (7)	Consejo Superior de Investigaciones Cientificas *	ESP		23.91
8 (8)	University of Tokyo	JPN		23.51

Scientific distribution: a multidisciplinary approach

CSIC
Consejo Superior de Investigaciones Científicas

Human and Social Sciences

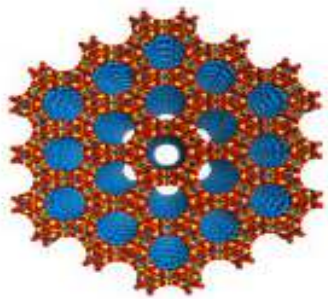


Biology and Biomedicine

Natural Resources

Agricultural Sciences

Physics



Chemistry

Food Science and Technology

Materials Science and Technology

NANOTECHNOLOGY IN CSIC

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

13 Institutes/centers of CSIC conduct research in nanotechnology.

- **Institutes of material science have shifted their research from "Bulk" material to nanomaterials.**
- **Institutes of microelectronic have shifted their research from micro to nano-world.**
- **2 new centers focus on nanotechnology:**
  - ❖ **Institut Català de Nanociència i Nanotecnología (ICN2)**
  - ❖ **Centro de Investigaciones en Nanotecnología y Nanomateriales (CINN)**

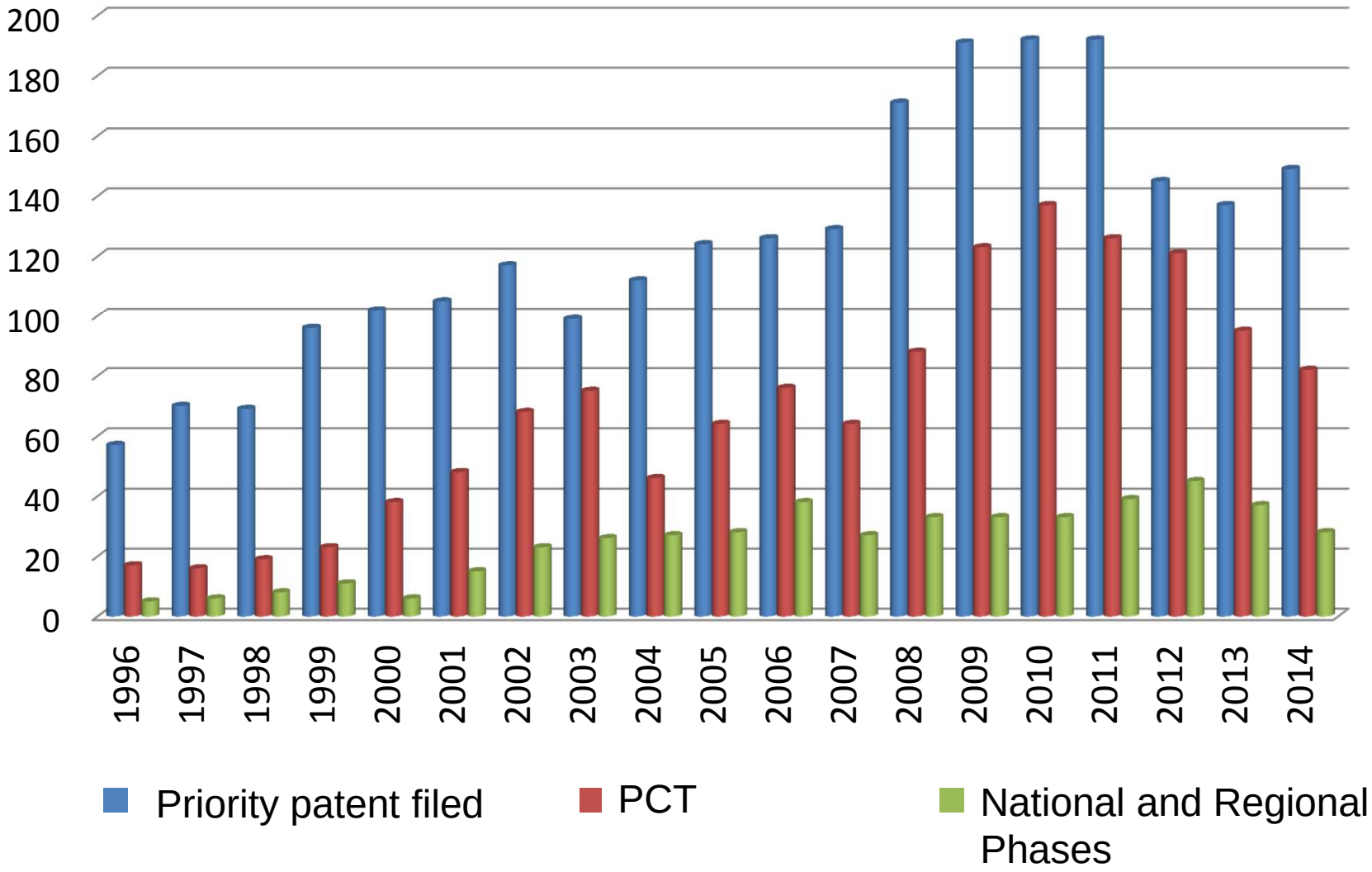
103 CSIC research Groups working in Nanotechnology (53 registered in NanoSpain)

ICN2 Institut Català de Nanociència i Nanotecnologia

cinn

CSIC Patents

CSIC
Consejo Superior de Investigaciones Científicas



CSIC IPR in Nanotechnology

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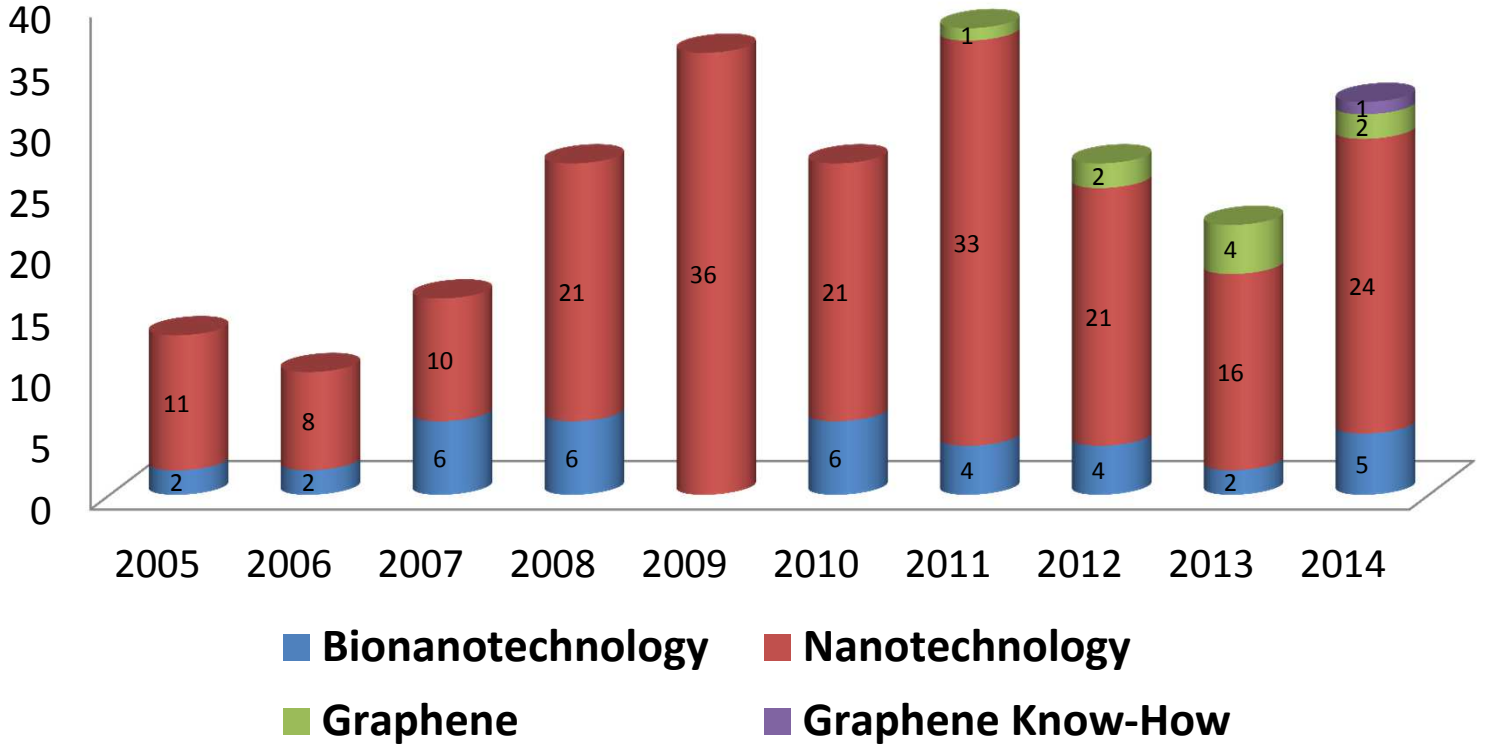
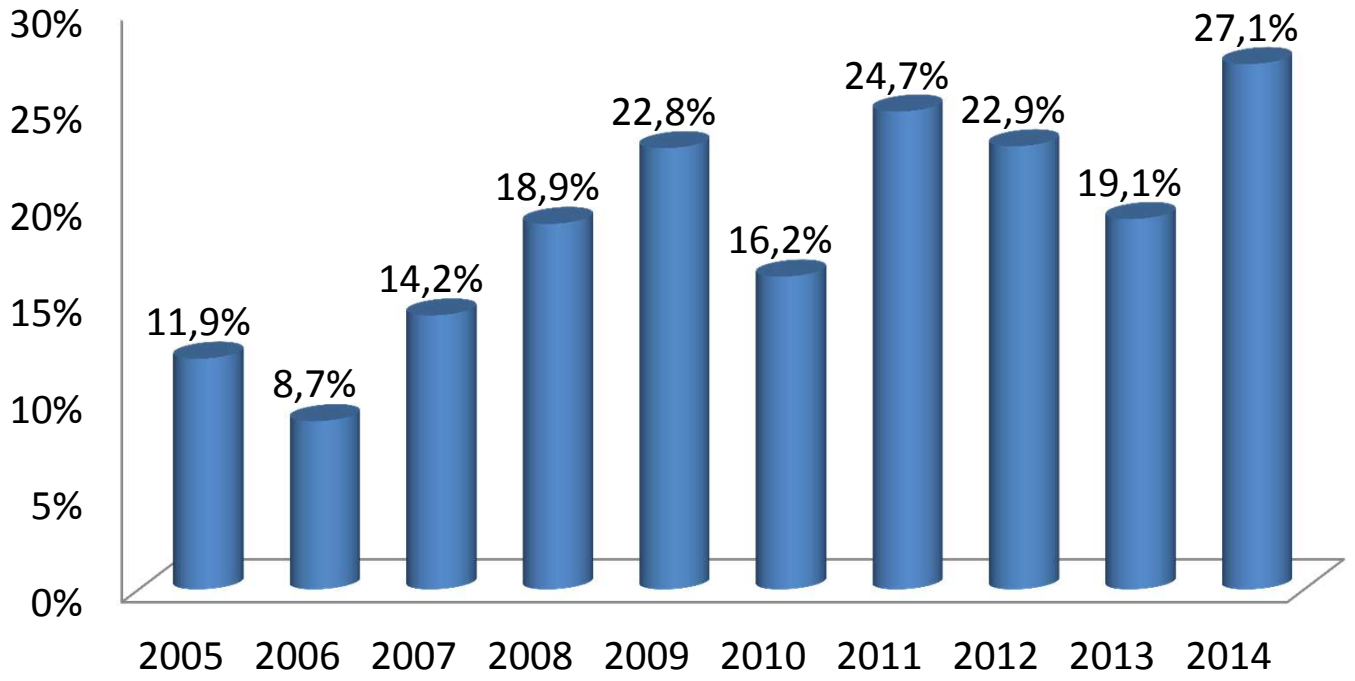
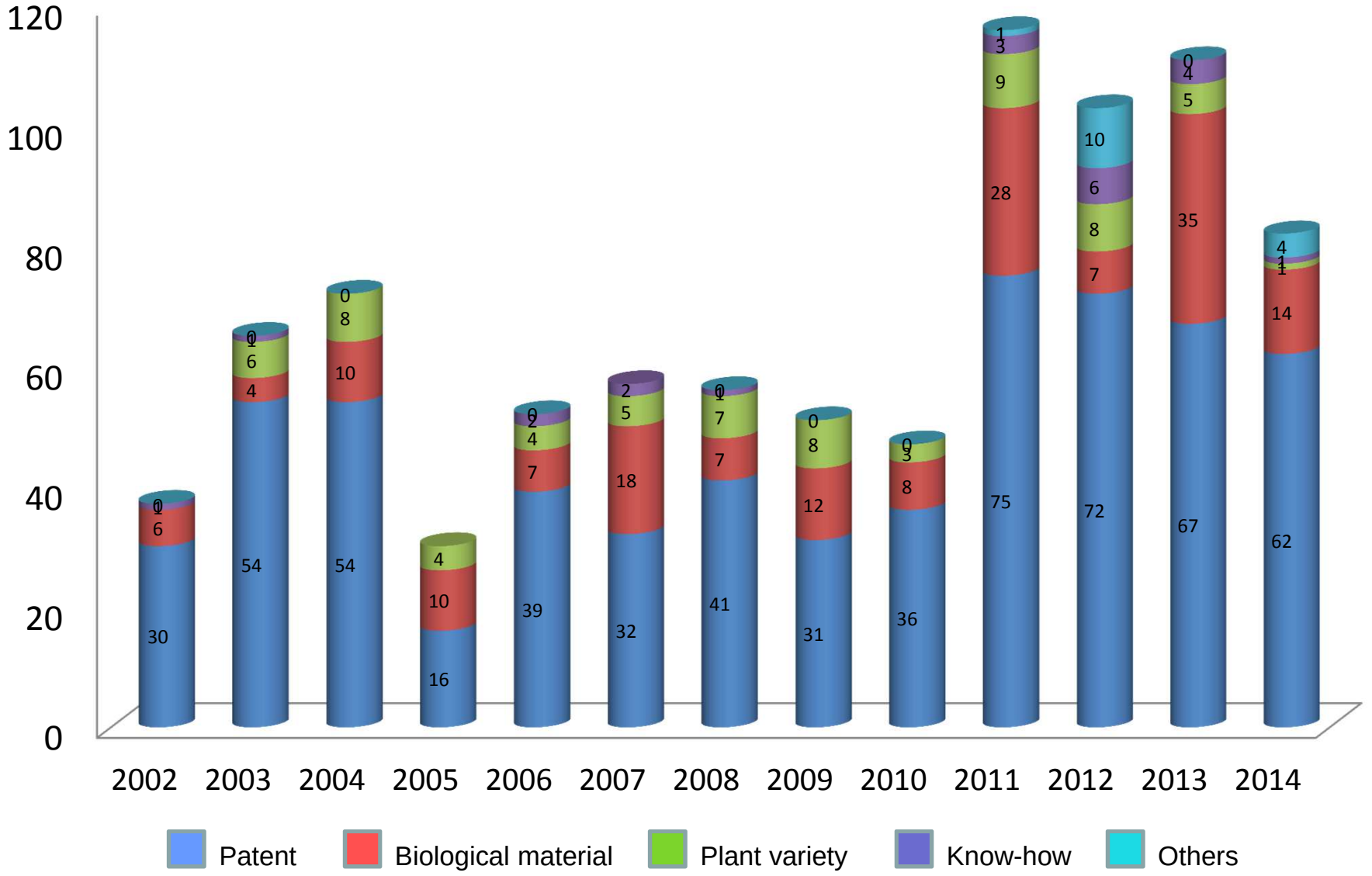


CSIC Patent Applications in Nanotechnology



Percentage of CSIC nanotechnology-patents over the total-patents

CSIC Licensed IPR



CSIC Licensed Patents in Nanotechnology

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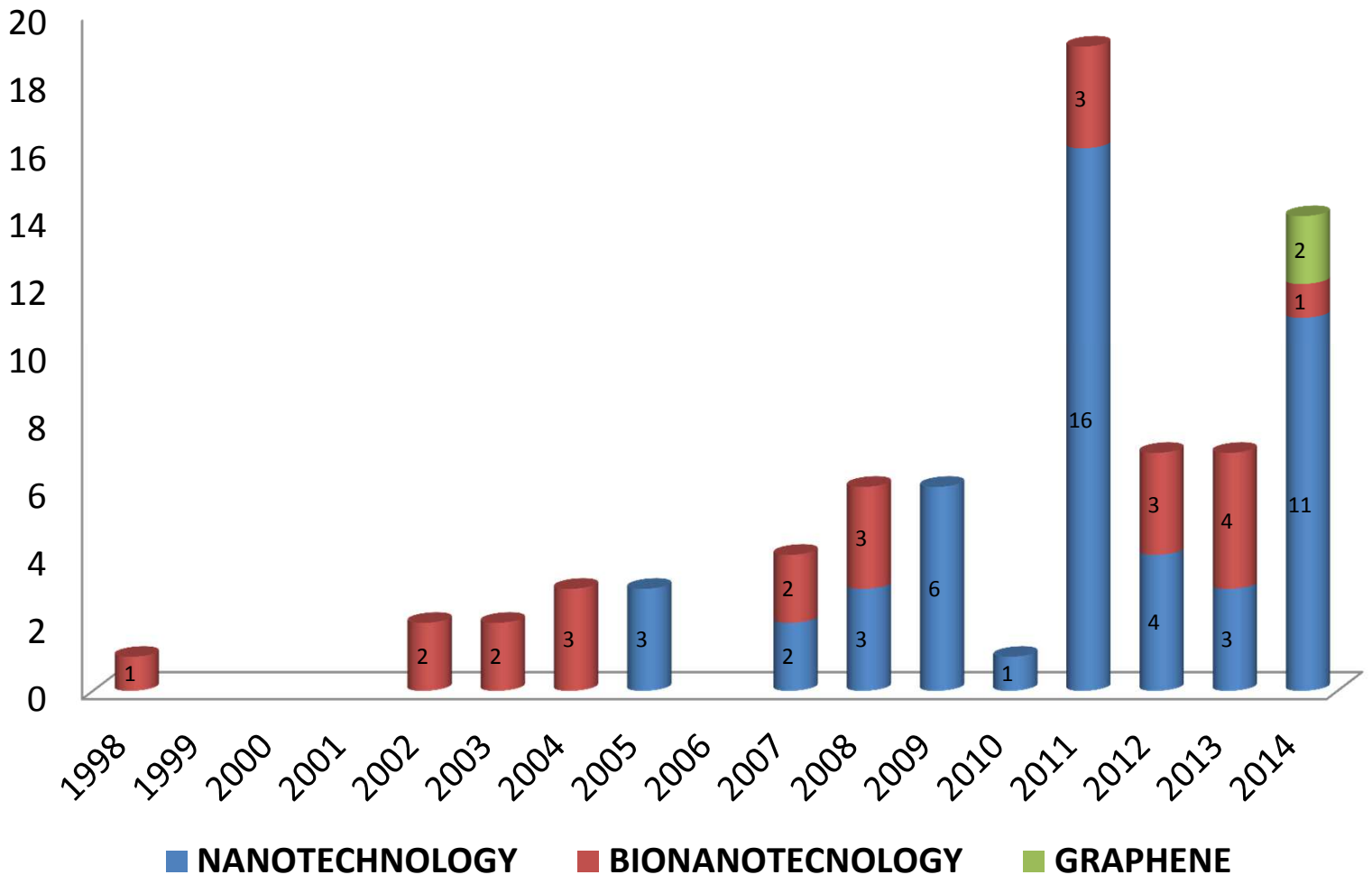
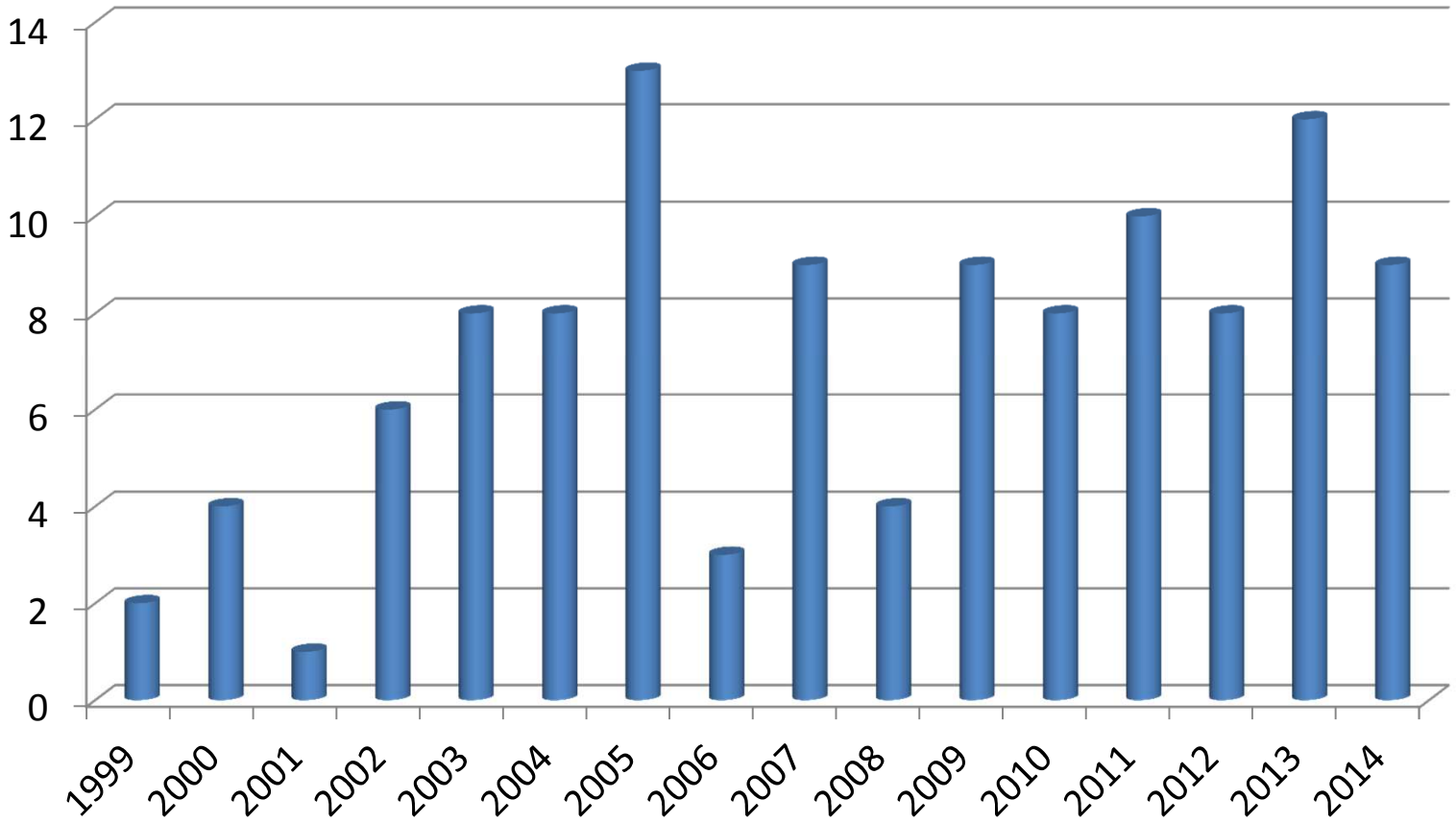
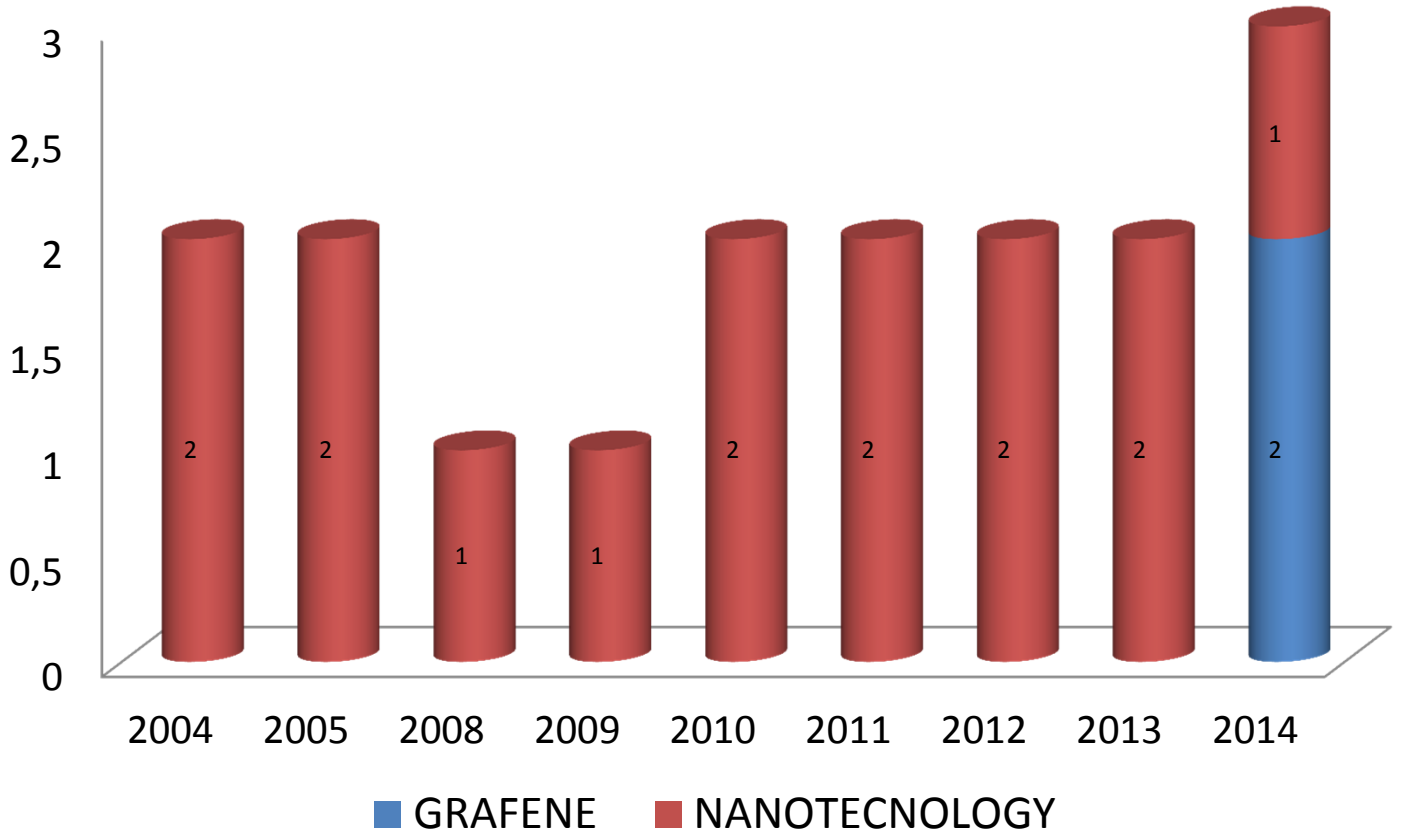


CSIC Spin-off companies

CSIC
Consejo Superior de Investigaciones Científicas



CSIC Spin-off companies in the area of nanotechnology



CSIC Spin-off companies in the area of nanotechnology

CSIC
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nanoker research
TAKING PROFIT FROM THE SMALL

mecwins
Innovation in nanomechanics for biotechnology

nanomol
Technologies

OXOLUTIA

CSIC Technology Transfer in Nano

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

CSIC Technology Transfer in Nanotechnology:

- **241** patent filed since 2005
- **75** licensed patents (47 in the last 4 years)
- **16** Spin-off created in the last 11 years

In which field of the nanotechnology?

Which kind of problems can be solved by using this nanotechnology patent?

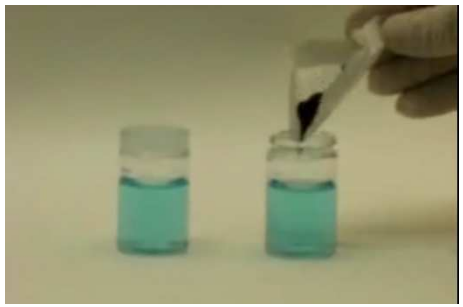
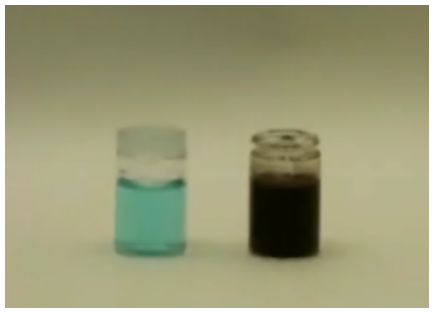
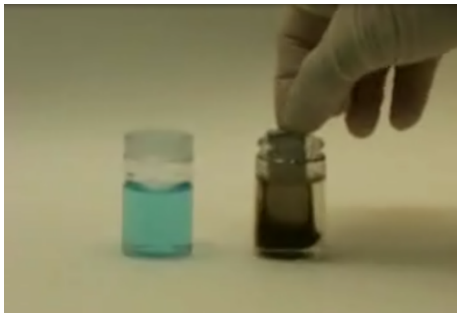
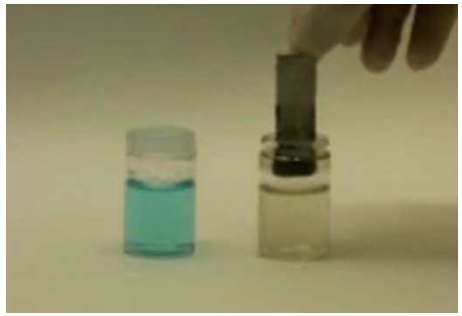
CSIC
Consejo Superior de Investigaciones Científicas

Nanotechnology for removal of toxic pollutant

Magnetite nanoparticles integrated in adsorbent materials (as charcoal, silica, zeolites, clays, etc.)

LICENSED

- **Removal of toxics pollutants**

- **Removal of radioactive ^{134}Cs and ^{137}Cs isotopes released during nuclear accidents (Chernobyl 1986, Fukushima 2011): magnetite nanoparticles integrated in silica and silicates – an Cs ion adsorbent.**

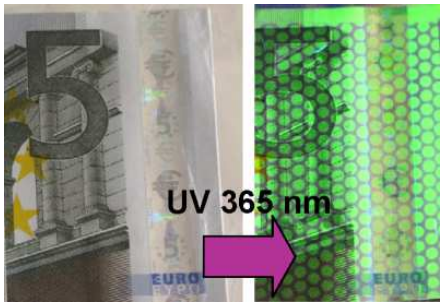
CSIC
Consejo Superior de Investigaciones Científicas

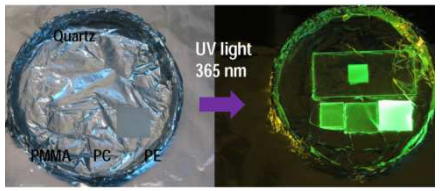
Nanotechnology for security applications

Two main projects:

1.- New method to tag objects based on:

- An invisible nanometer-thick layer of a luminescent polymer deposited on a support by plasma polymerization.
- Micrometers scale patterns are recorded by laser, that become visible under illumination at specific wavelength.





2.- Nano-particles of oxide materials for security components.

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

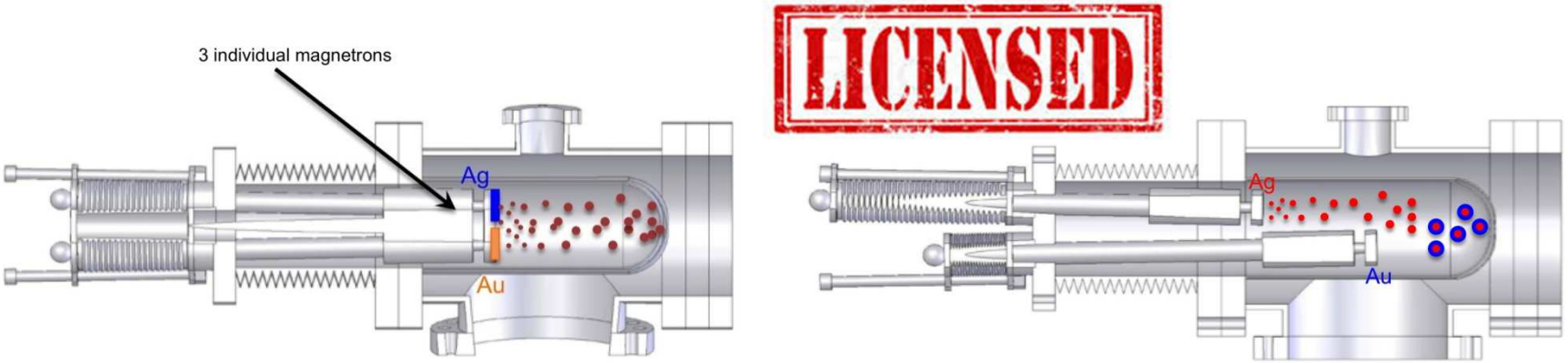
Method for the fabrication of nanoparticles

Sputtering process: By using a ICS "ion cluster source" nanoparticles are extracted from the target by bombardment of ions and are deposited on a substrate as a thin film. Magnetron: a distribution of magnets to accelerate the extraction process.

A modified Ion Cluster Source: Three magnetrons of smaller size with an independent system of positioning and power, and a careful manipulation of working conditions.

This modified ICS allow:

- **the control of the chemical composition by combination of the 3 different targets**
- **the control of the size of the particles.**
- **Adapt the properties of the nanoparticles to the desired application: core/shell**



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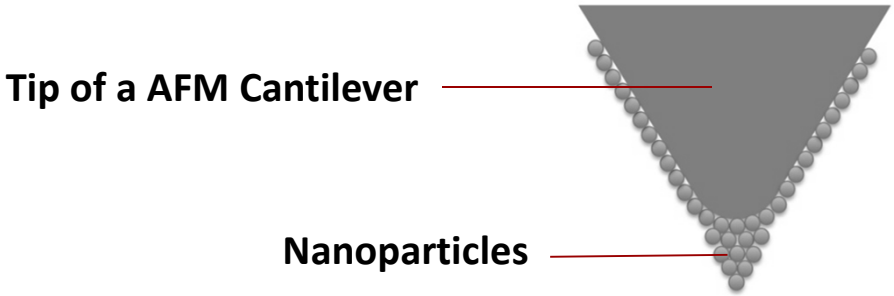
Nanoparticles for characterization instruments

The resolution limit of an Atomic Force Microscope (AFM) is set by two parameters of the AFM tip:

- **The "aspect ratio" (result of dividing the height by the width of the tip)**
- **Chemical composition: by "functionalization" of the tip, adding compounds to the surface, it is possible to enhance its performance.**

Method to modify the chemical composition and aspect radio of AFM tips by the deposition of nanoparticles of controlled size generated with an Ion Cluster Source (ICS).



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Nano-capsules

- ***Nano- encapsulation of flavors and scents*** **for the introduction of smell in product marketing: scented ink with nano-capsules.**

- **Encapsulation of compounds into metalorganic particles (spherical particles of 100 nm diameter). This nano-capsules are stable in solid phase for long periods of time (1 year) and relieve the compound in contact with water. Application for plant protection products and fertilizers.**

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Nanotechnology for biomedical applications

Nanoceramics and nanocomposites as bactericide and fungicide materials for dental implants.

A fast fabrication method to obtain yttria-stabilized zirconia of different colors for dental prosthesis.

The patient will be able to get the dental prosthesis in 24-48h.

CSIC Technology Transfer in Nano

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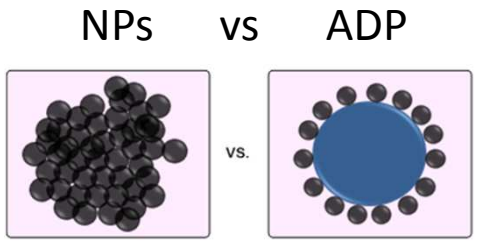
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Safe handling of nanoparticles

Use of nanoparticles avoiding healthy risks



Method for dry dispersion of nanoparticles in a microparticle of an specific carrier:

- **Avoid particle agglomeration:**
  - **higher surface area.**
  - **Lower amount of particles is required for surface coating – reduce of final costs.**
- **Avoid healthy risks related with the used of nanoparticles in solid phase since the nanoparticles are anchored to form hierarchical structures.**

The company has launched new products consisting of the incorporating of TiO2 nanoparticles for absorption of UV in sunscreen (Nanofree sunscreen - no free nanoparticles).

Spin-off Sep. 2011
Market Nov. 2013
Sales 2014 600Kg

CSIC Technology Offer in Nano

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Business Matching Award in nanotech 2015 (Tokyo)

For CSIC contribution to innovation by means of technology Transfer.

Deputy Vice presidency for Knowledge Transfer

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

CSIC Deputy Vice-presidency for Knowledge Transfer

Serrano 142, 28006-Madrid, España (Spain)

e-mail: comercializacion@csic.es

USC and Nanotechnology

Susana Torrente Vilasánchez

Technology Transfer Project Manager

Universidade de Santiago de Compostela

The University

- More than 500 year-old
- One of the most relevant institutions for research in Spain.
- 1.900 FTE academic staff
- 1.000 FTE research staff
- About 30.000 students

Research: some data

- External Funding for research (2014): 48,3 M Euros
- Total JCR papers (2014): 1.723
- Total Thesis (academic year 2014): 241

- 26 Centers and Institutes for Research
- 1 University Hospital (1.200 beds)
- 1 Veterinary Hospital

- 26.000 Degree students
- 2.400 Master students
- 2.800 PhD Students
- 383 Postdocs

Results

Protection

Evaluation

Transfer of K

Proof-of-concept

License

Spin-out

Technology Transfer and Entrepreneurship Office

2014 at a glance

45 PATENT APPLICATIONS
- 21 PRIORITY PATENT APPLICATIONS
- 24 INTERNATIONAL EXTENSIONS
- 1ST SPANISH UNIVERSITY IN PCT APPLICATIONS (2004-2011)
- 23 GRANTED PATENTS

37 DEALS
- 6 TRANSFER AGREEMENTS
- 21 CONFIDENTIALITY AGREEMENTS
- 10 MATERIAL TRANSFER AGREEMENTS

PROYECTO VT

PROJECT VT TRANSFER VEHICLES

210 REGISTERED RESULTS

3 FORMATIVE ITINERARIES

5 SPIN-OFFs SET UP

5 COMPANIES QUALIFIED AS EBT

1 2014 REPORT

16 INVESTOR MEETINGS

120 TRAINING HOURS

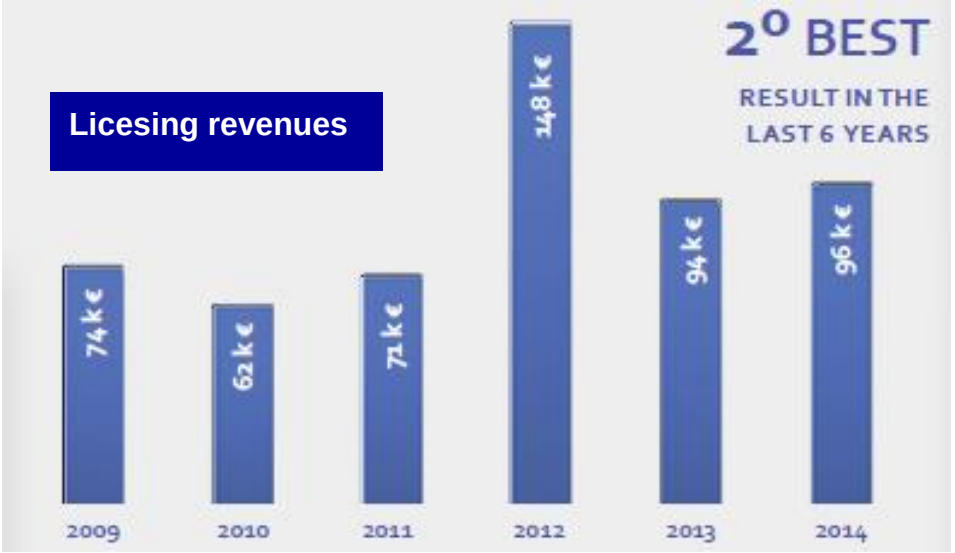
8 PROJECTS PRESENTED IN COMPETITION

3 FINALISTS

Technology Transfer and Entrepreneurship Office

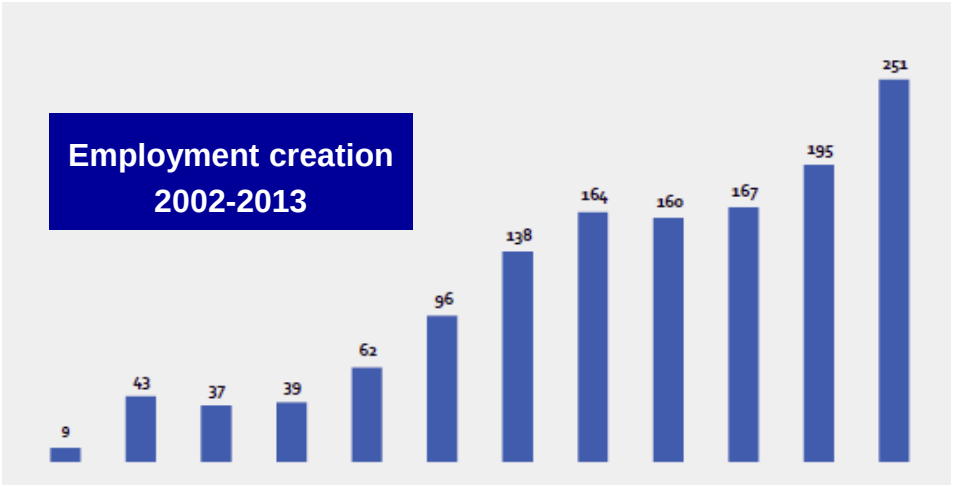
Knowledge TRANSFER

Proof of Concept → **Licensing spin-out**

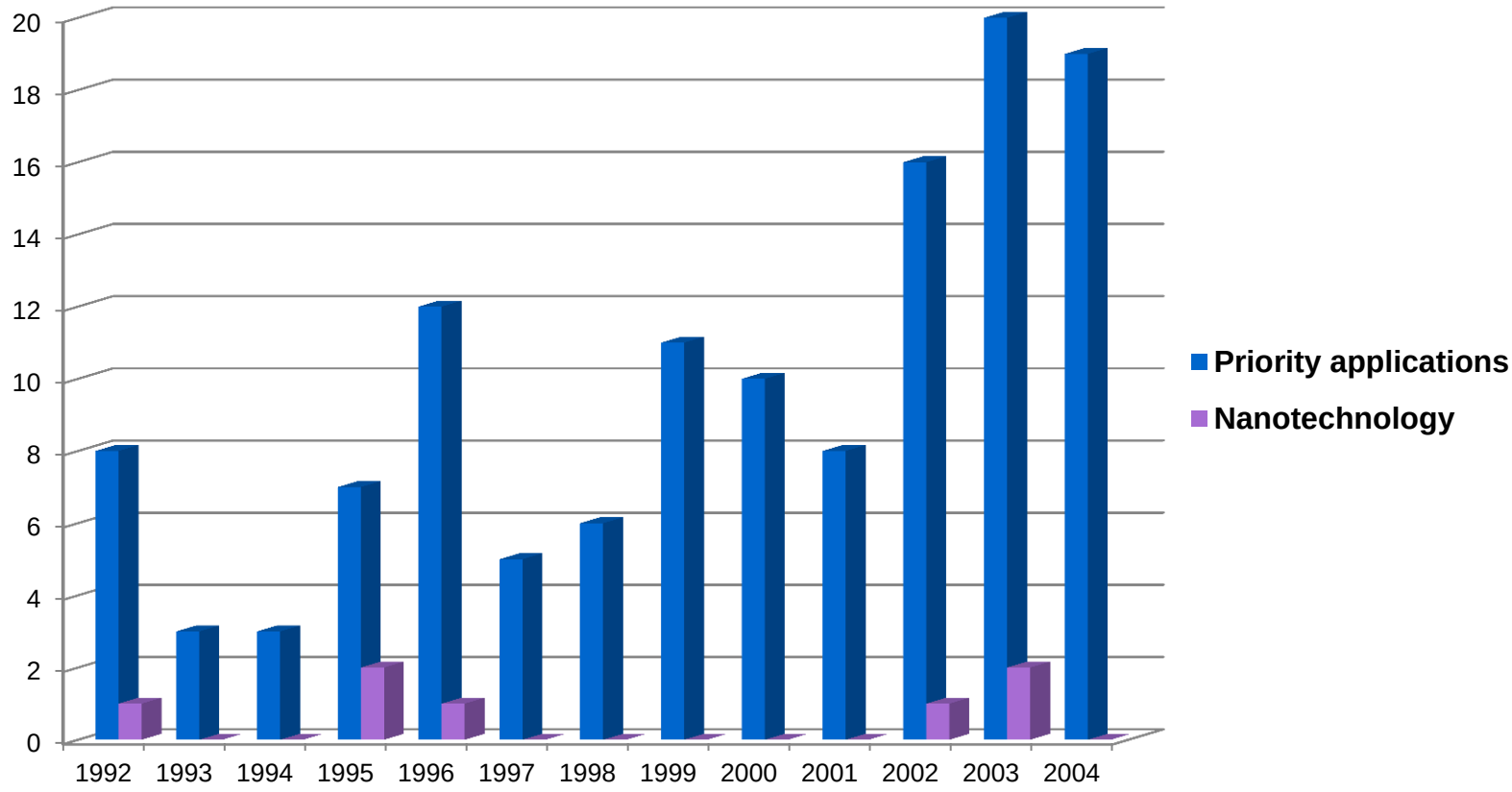


argos CREANDO EQUIPOS EMPRENDEDORES

- BUILD A TEAM
- BUILD A BUSINESS PLAN OR A COMMERCIALIZATION STRATEGY



Video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Priority applications
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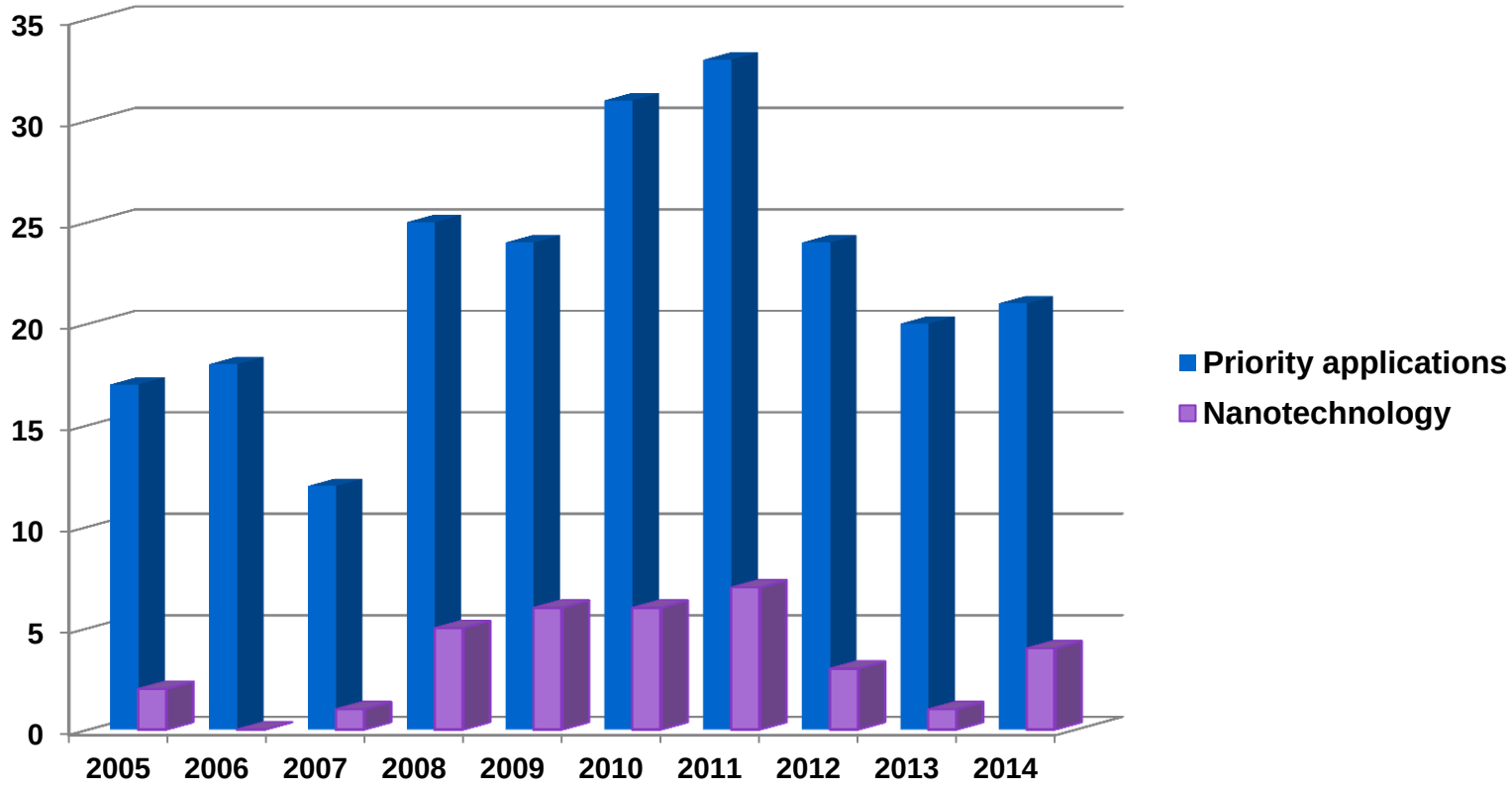
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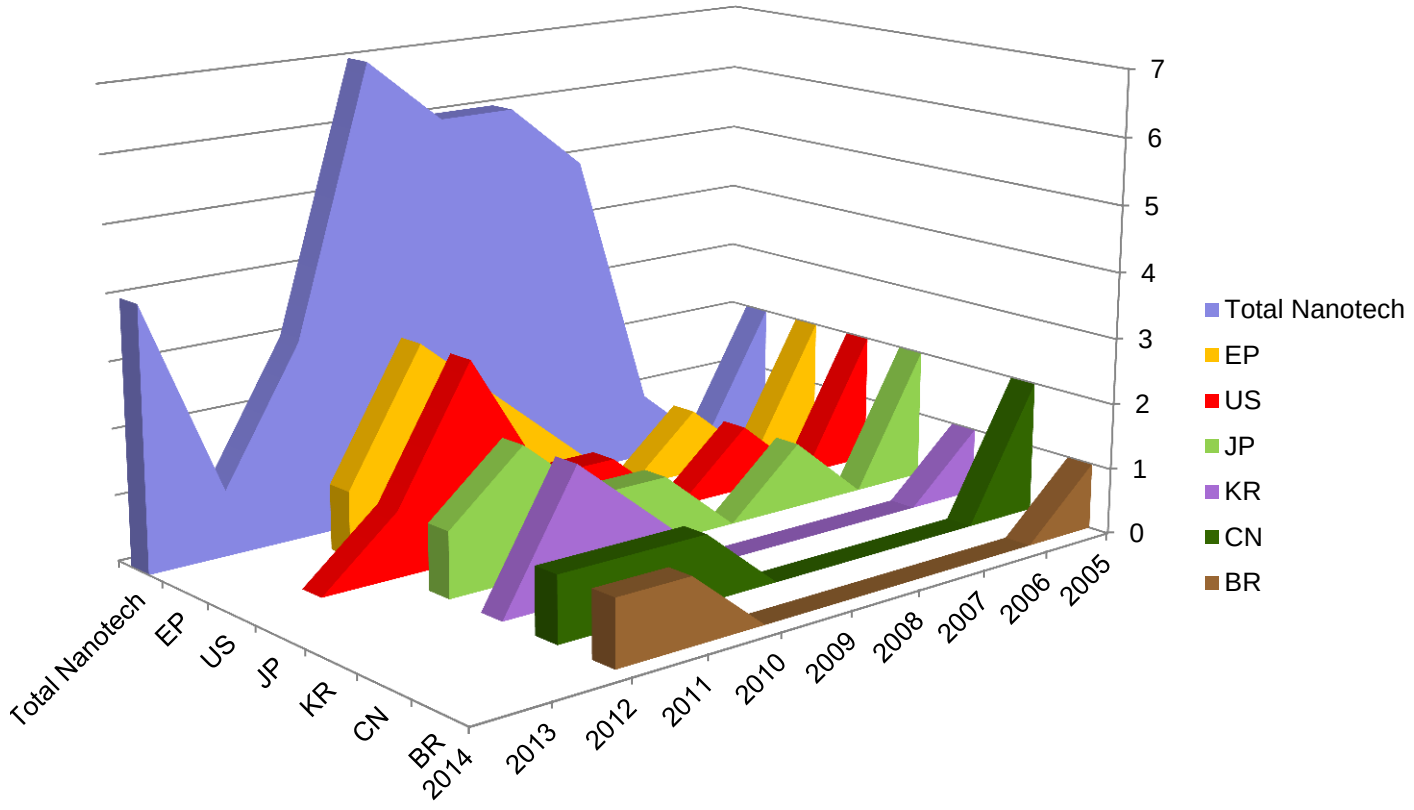
Priority applications
Nanotechnology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2011
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2013
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(19) OFICINA ESPAÑOLA DE PATENTES Y MARCAS

ESPAÑA

(11) N.° de publicación: **ES 2 051 214**

(21) Número de solicitud: 9200433

(51) Int. Cl.[5]: B01J 13/02
A61K 9/50
A61K 9/51

(12) PATENTE DE INVENCION B1

(22) Fecha de presentación: **27.02.92**

(43) Fecha de publicación de la solicitud: **01.06.94**

Fecha de concesión: **28.10.94**

(45) Fecha de anuncio de la concesión: **16.12.94**

(45) Fecha de publicación del folleto de patente: **16.12.94**

(73) Titular/es:
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15706 Santiago de Compostela, Coruña, ES
José Blanco Méndez

(72) Inventor/es: **López Quintela, Manuel Arturo y Blanco Méndez, José**

(74) Agente: **Gómez-Acebo Pombo, J. Miguel**

(54) Título: **Procedimiento para la obtención de nanopartículas por polimerización en microemulsiones.**

(57) Resumen:
Procedimiento para la obtención de nanopartículas por polimerización en microemulsiones formadas por nanogotas. Comprende (a) disolver uno de los reactivos de polimerización dentro de las nanogotas de la microemulsión; (b) disolver el otro reactivo, bien dentro de las nanogotas de otra microemulsión similar a la anterior (para la obtención de nanoesferas) o (c) mezclar ambas microemulsiones al objeto de que se produzca la reacción de polimerización; (d) extraer o separar las nanopartículas del medio de reacción.

NANOMAG
Magnetism & Nanotechnology Group

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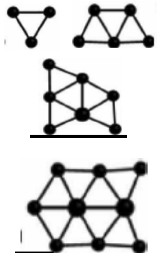
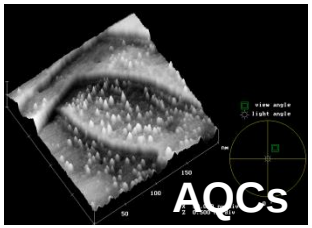
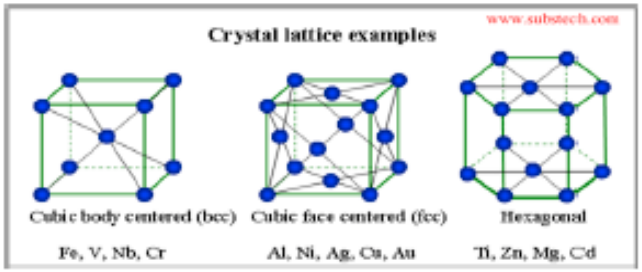
Atomic Quantum Clusters





Metal Nanoparticles

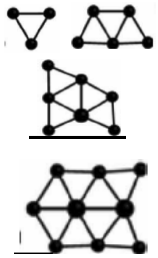


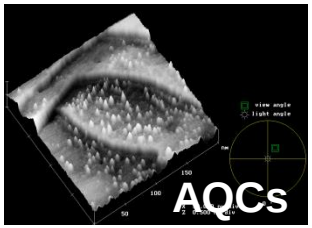
Differences in:
Structure, Electronic structure, Optical properties, Physical/Chemical properties

- Clusters of between 2 and 150 atoms, and **0.5 to 2 nm in size**
- Quantum confinement
- Ban Gap like semiconductor
- Low melting/sintering temperature
- Fluorescent properties
- Enhanced properties over NP's

- Particles more than **2 nm** up to **100 nm**
- Well defined 3D crystalline structures
- Metallic bonding and delocalised electrons, no Band Gap
- High melting/sintering tempreature
- It can exhibit plasmon band

Atomic Quantum Clusters





Remarks:

The size and the structure of the nanosystem are important

NANOMAG
Magnetism & Nanotechnology Group

NANOGAP SUBnmPARTICLES

Anisotropic metal nanoparticles

ES 2365313 B2
EP 2547477 A1
US 8,696,786
JP 2013522469
KR 20130059333
CN 102947026

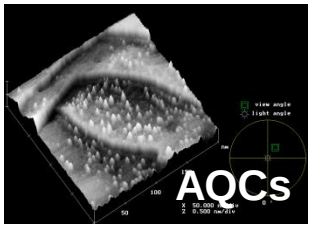
Luminiscent nanosystems

EP 2721120 B1
US 2014106465 A1
JP 2014523932
KR 20140064734

Therapeutic applications

Oncology

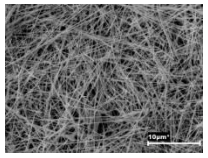
EP 10382289



Photoconversion of light

EP 2785456 A1
US 2014318980
JP 2015506817
KR20140107349

ES 2277531 B2
EP 1914196 A1
US 2009035852 A1
JP 2015063759 A1
KR 20080039467 B1
CN 101248003



Conductive inks

ES 2360649
EP 2505616 A1
US2012315495 A1
JP 2013512300 A1
KR2012113739 A1

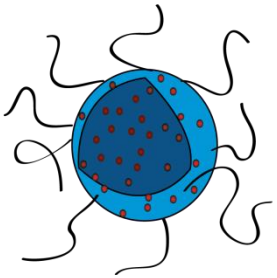
Biocidal agents

ES 2319064 B1
EP 2206503 A1
US 2010215766
JP 2011504459

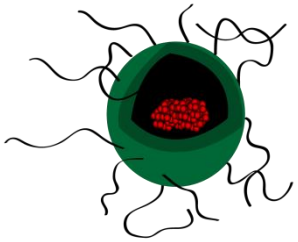
Antimicrobial coatings

Nanobiofar - Nanomedicine and Drug Delivery

María José Alonso



Nanoparticles



Nanocapsules

Some research projects at present:

ORAL PEPTIDE DELIVERY - THE "TRANSINT" EUROPEAN CONSORTIUM

ONCOLOGICAL NANOTHERAPIES - THE "NICHE" EUROPEAN CONSORTIUM

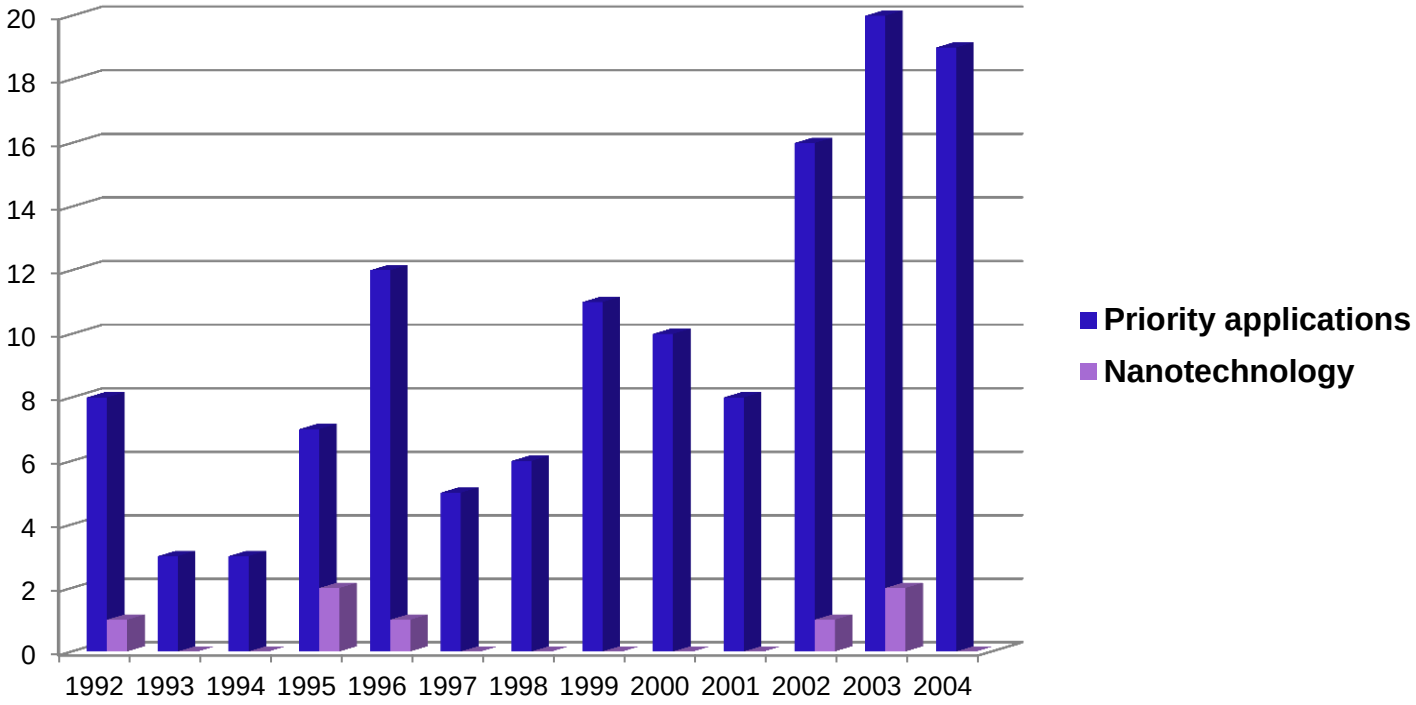
NANOVACCINES - THE HIV NANOVACCINE CANADIAN AND EUROPEAN CONSORTIA

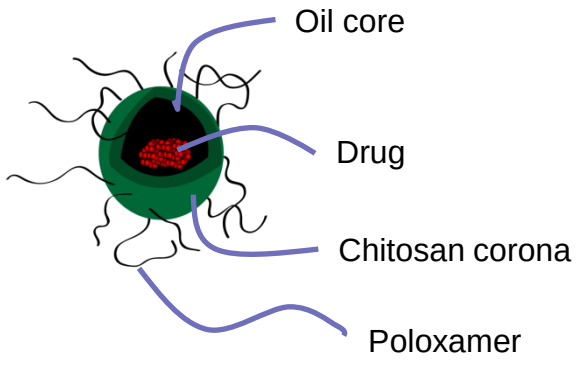
OCULAR DRUG DELIVERY - THE SPANISH SURFEYE CONSORTIUM

Others:

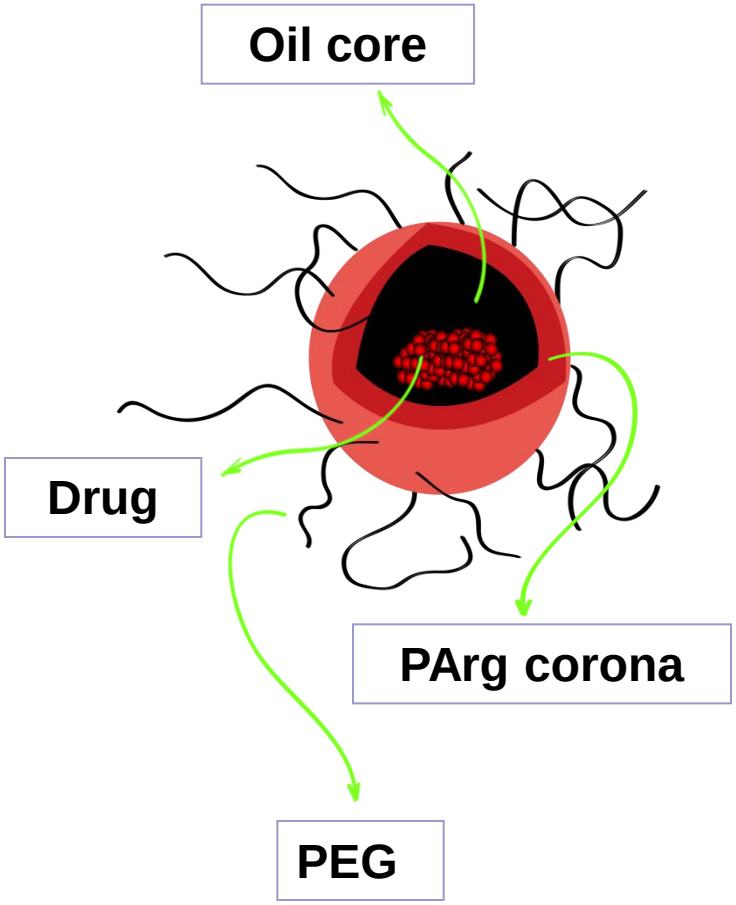
BILL&MELINDA GATES FOUNDATION

SCALE-UP OF NANOMEDICINES: NANOPILOT





A highly efficient system to enhance the transmucosal transport of molecules by different administration routes.

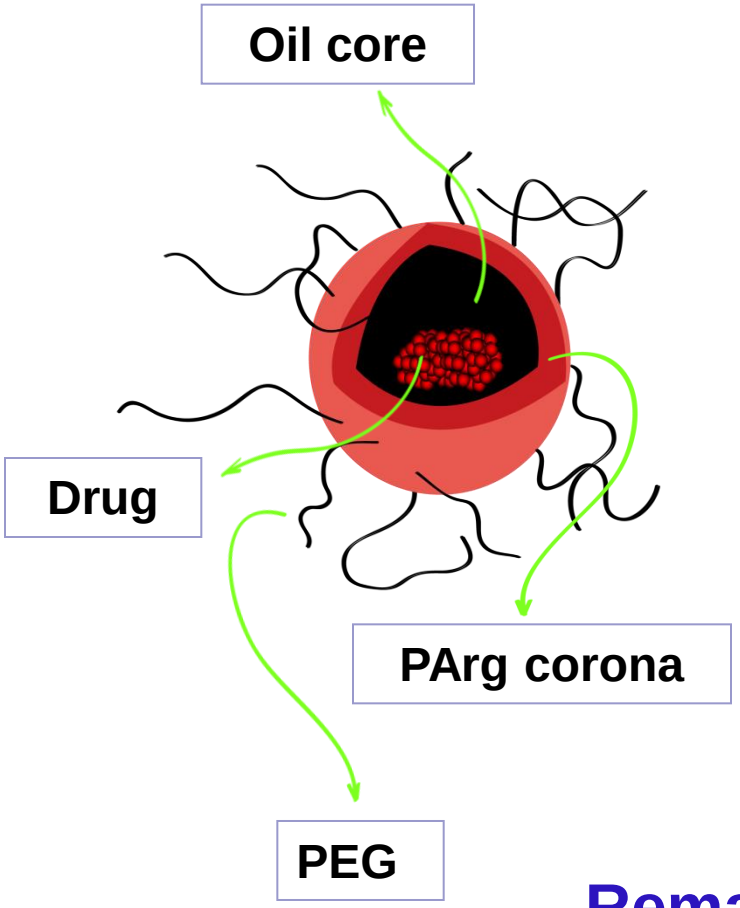


Nanocapsules of Polyarginine

ES 2347119 B2
EP 2422776 A1
US 2012121670 A1
CN 201080027912
BR 1014412

	EE (%)
PArg NCs	74%
Nanoemulsion	22%

PArg shell is essential in the encapsulation of docetaxel, enhancing the EE from 22% to 74%



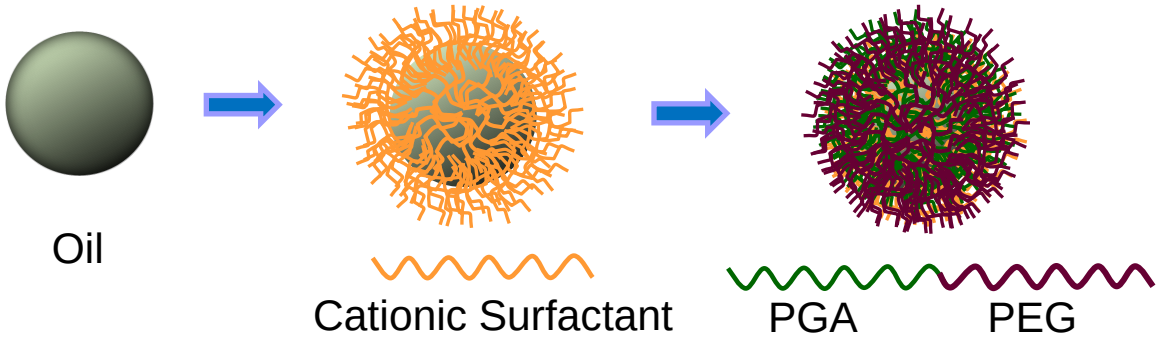
Nanocapsules of Polyarginine

ES 2347119 B2
EP 2422776 A1
US 2012121670 A1
CN 201080027912
BR 1014412

Remarks:

the structure of the system is important

Nanocapsules of Polyglutamic-PEG



ES 2347119 B2
EP 2422776 A1
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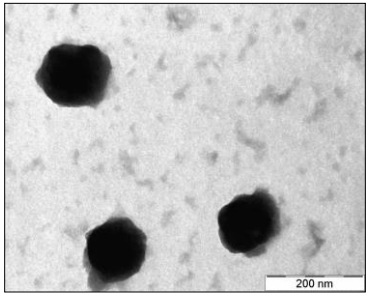
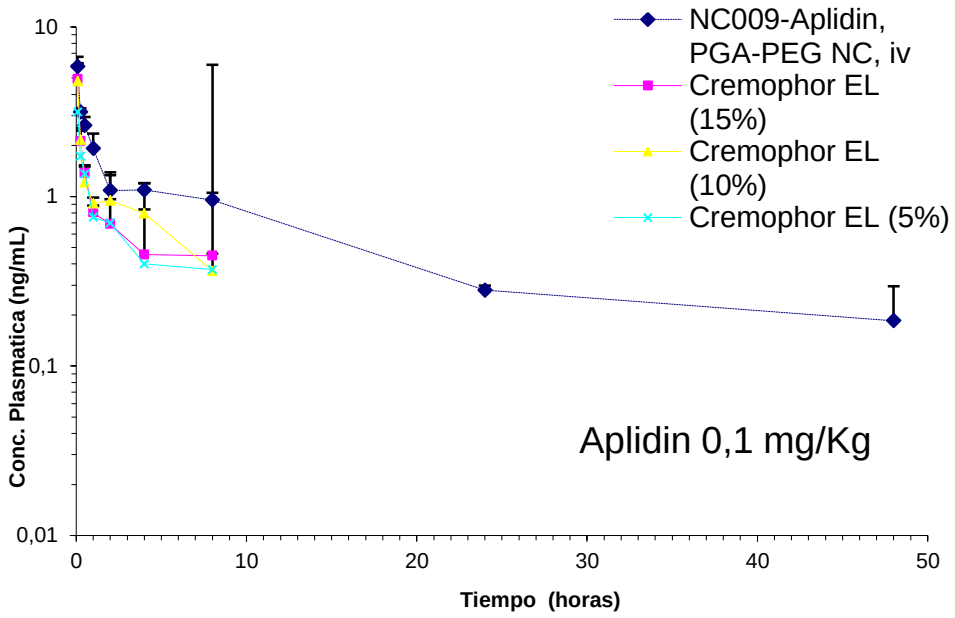
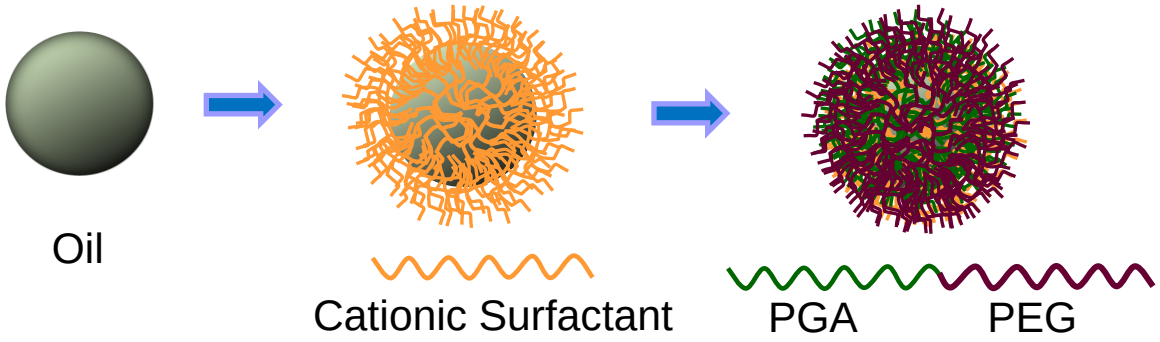
BR 1014412





NCs stabilize Aplidin and keep detectable levels after 48 h in plasma

Nanocapsules of Polyglutamic-PEG



ES 2347119 B2
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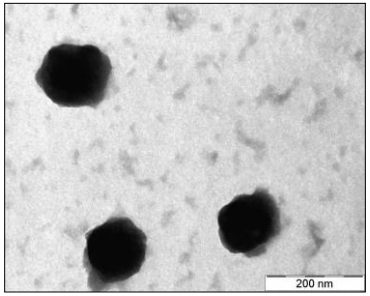


Remarks:

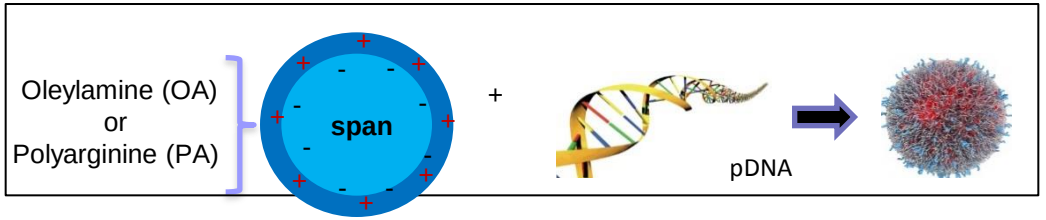
the structure of the system is important

Solid Span Nanoparticles

-Low-cost pharmaceutical grade commercialized components

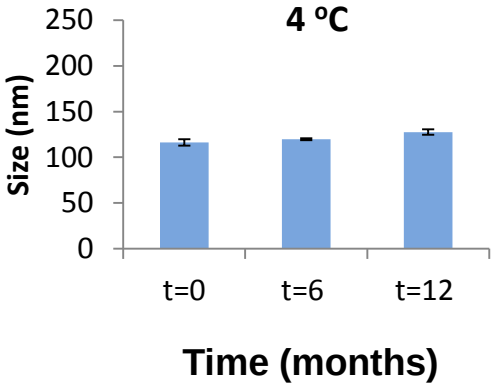
-FDA ingredient regulatory classification: 'generally recognized as safe' (GRAS)

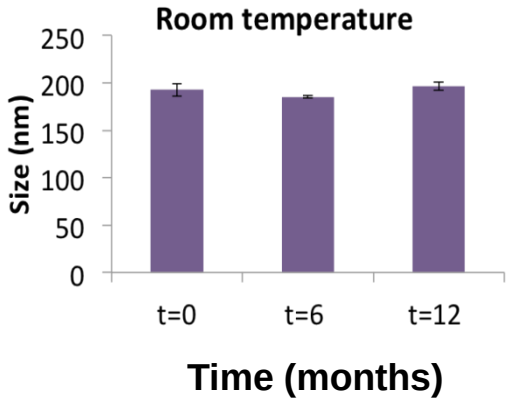
-Broad use as excipients in the pharmaceutical and cosmetic industries



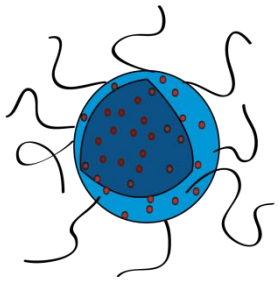
Formulation	Size (nm)	PdI	ζ Potential (mV)
SSN-OA	192 ± 11	0.091	+41 ± 7
SSN-PA	238 ± 25	0.104	+27 ± 2
SSN-OA-pDNA	304 ± 28	0.158	-13 ± 4
SSN-PA -pDNA	247 ± 22	0.143	-17 ± 10

Improved stability profile as compared to different nanosystems

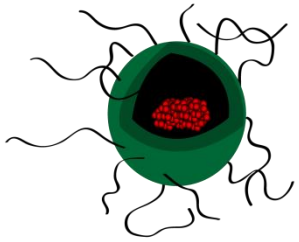




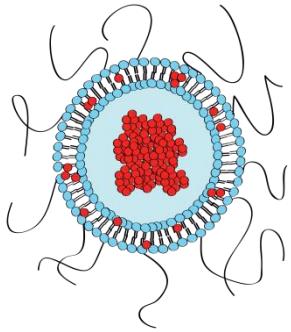
WO2013068625 A1, priority date: Nov 11th, 2011



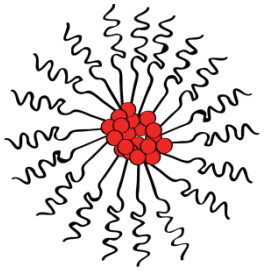
Nanoparticles



Nanocapsules

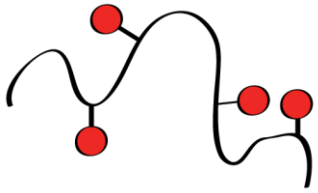


Liposome

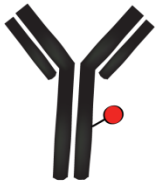


Micelas

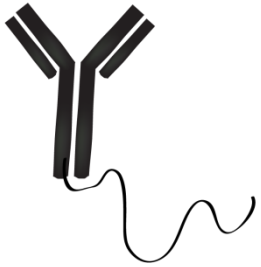
Dendrimer



Conjugated active-polimer



Conjugated active-antibody



Conjugated antigen-polimer

Size and Design

Valorization and Transfer Unit

Edificio EMPRENDIA. Campus Vida

15782, Santiago de Compostela

Susana Torrente Vilasánchez

susana.torrente@usc.es

Phone: +34 881 815 585

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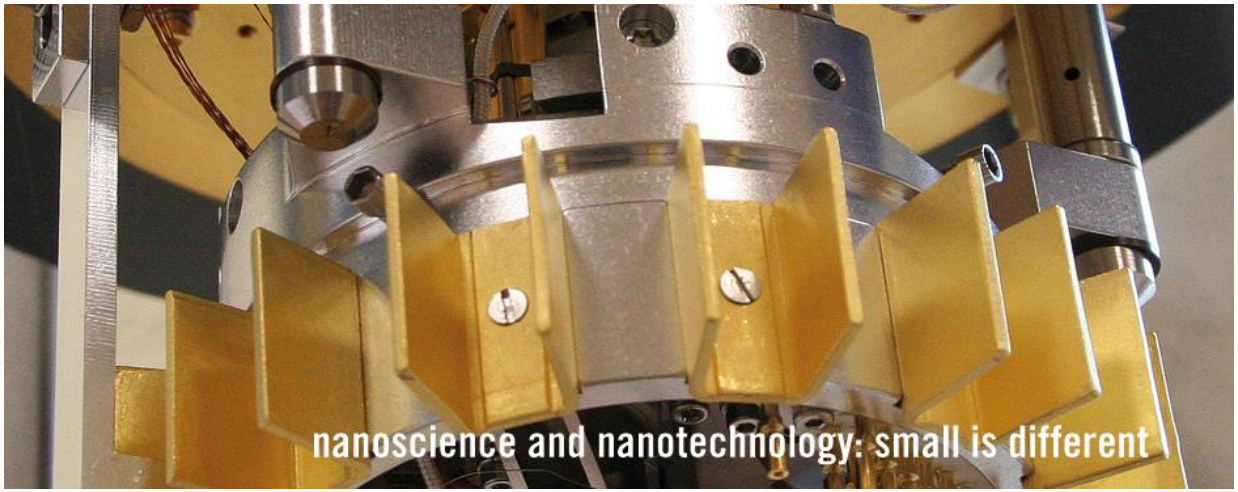
Scientific Excellence at the Nanoscale



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IMDEA Initiative

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Presentation at COTEC 27/11/2006

Urban agglomeration
Traditional services
Leisure and vacation
Low productivity

Drained Economic Model

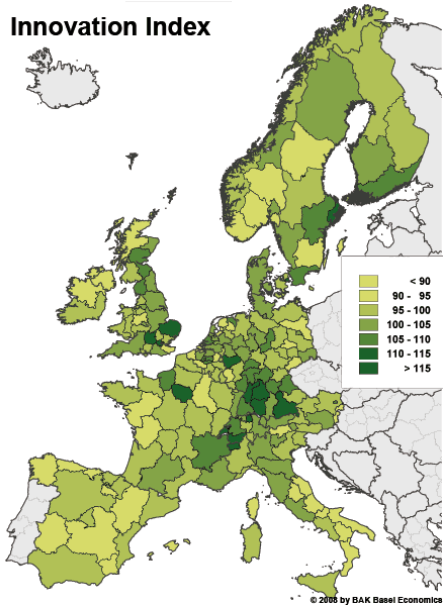
SCIENCE
RESEARCH OF EXCELENCE
In the frontier of knowledge

INDUSTRY
COMPETITIVE PRODUCTS
In the frontier of markets

fundación imdea
instituto madrileño de estudios avanzados

New Economic Model

Knowledge society
High Tech Industry
Advanced products and services
High Productivity



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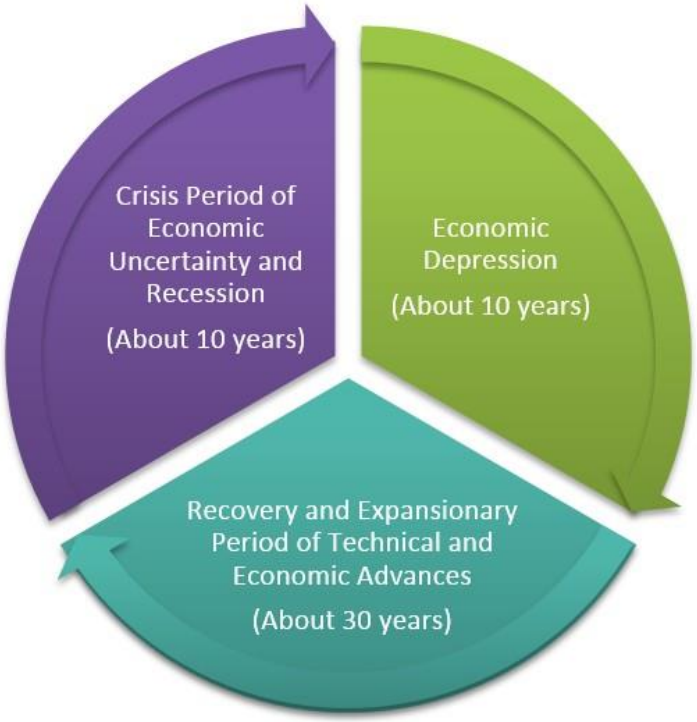
Nanoscience Revolution

- Kondratieff Waves
- 50 year cycles
- Bursts of disruptive product or service innovations
- Lag between discovery, invention and innovation
- Sixth wave: now
- Change is in the air
  - Social
  - Cultural
  - Economic
  - Technical
- Pressures. Environmental



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Nanoscience Revolution

Waves:	1st Wave: Industrial Revolution	2nd Wave: Industrial Production	3rd Wave: Scientific Revolution	4th Wave: Scientific-Technical Revolution	5th Wave: Information and Telecom Revolution	6th Wave: … Nanotech Revolution
Date range:	~1780 – 1830	~1830 – 1880	~1880 - 1930	~1930 – 1970	~1970 - 2010	~2010 – 2050
Economic trend (US S&P 500)						
Key developments	Steam engine, industrialization	Railways, steel, heavy engineering	Electricity, chemistry, chemical industry	Automobile, mass production, petrochemical industry	Microcomputers, information, telecom	Nanomaterials, Nanomedicine, Spintronics, Quantum IT
Events near the peaks	War of 1812	US Civil War	World War I	Vietnam War, Six-Day War		
Events near the troughs		1873/79 Depression	1929 Depression	1974/80 Oil crises	2007/09 Financial crisis	

Source: SRC

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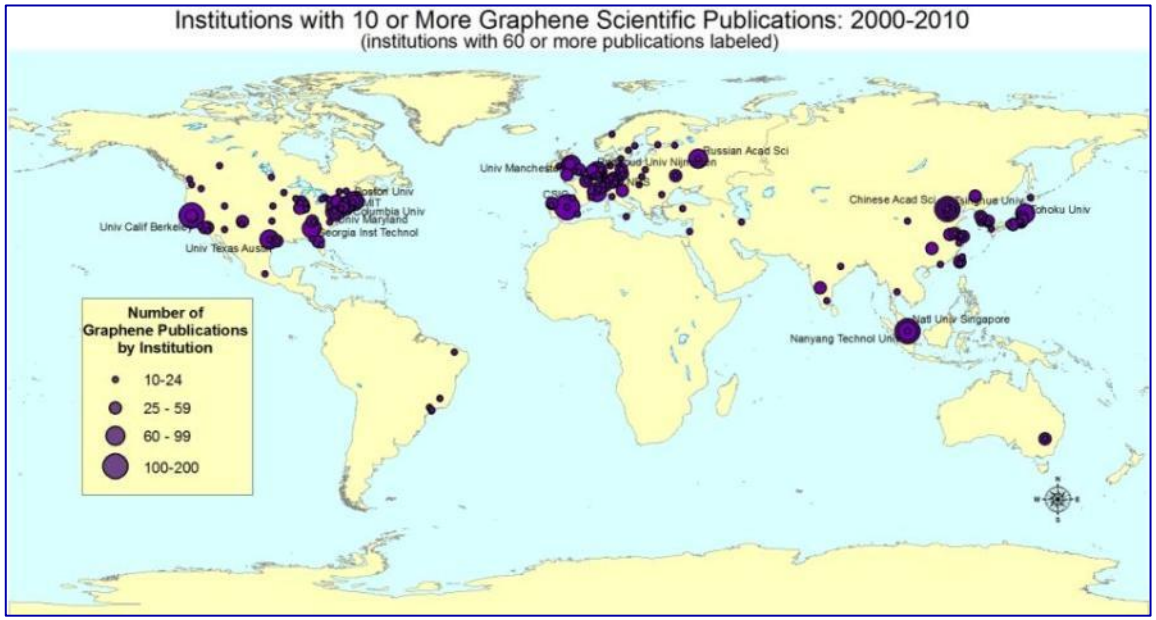
Madrid Graphene Hub

- 2004 **SNT³**
- Project for creation of **the Spanish National Nanotechnology Lab**
- Madrid: One of the World's **Graphene Research hubs**
  - UAM, ICM (CSIC)



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IMDEA Nanoscience

- Created in 2007 as a non profit foundation by **Region of Madrid**
- Agreement with the **Ministry of Education and Science** of Spain
- New framework for **science-business** partnerships: new economic model
- Financial support from **European Union** FEDER Technology and Social Funds and the **European Investment Bank**

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IMDEA Nanoscience

- A center for scientific research and technology development at the **nanoscale**
  - multidisciplinary + international + advanced
- Governed by an **independent Board of Trustees**
  - science + business + government
- With a new **purpose built** facility
  - state of the art instrumentation
  - world class equipment
- Made up of **high performance teams**
  - talent + motivation + attitude

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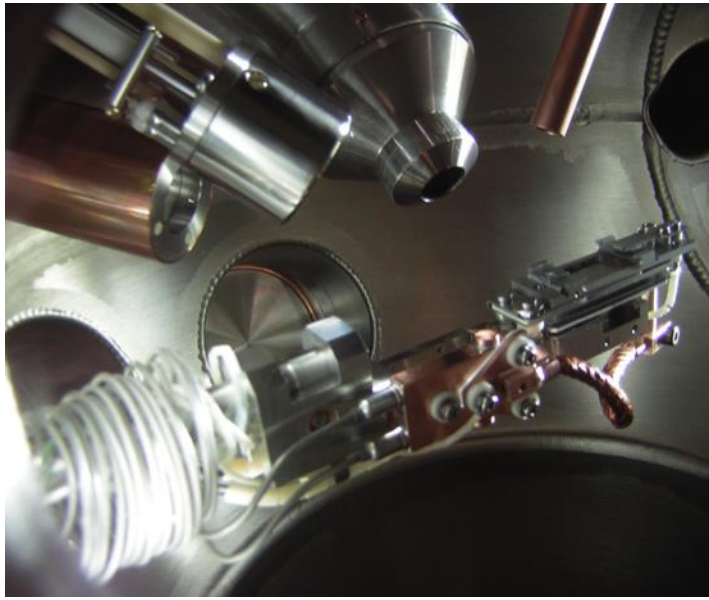
Relevant Figures

- ≥ 74 PhD's in 45 active projects
- 45 PhD Students
- 9 Research Programmes
- Building 10.000 m2
- 30 Labs and Research Infrastructures
- Centre for Nanofabrication
- Nuclear Magnetic Resonance
- Helium liquefier/Recovery System
- Advanced Microscopy
- Workshop



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Research Programmes

1. Molecular Nanoscience and Chemical Synthesis
2. Time-resolved Optical Spectroscopy
3. Scanning Probe Microscopies and Surfaces
4. 2D Systems
5. Transport at the Nanoscale
6. Nano Magnetism
7. Nanomedicine
8. Nanobiosystems: BioMachines and Manipulation of Macromolecules
9. Nanostructured Surfaces and Nanodevices

SNOM with high resolution optical spectrometer and an electron multiplier CCD.

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International Open calls

- Scientist selected world wide on the basis of research merit
- > 100 researchers: Senior, Junior, postdoctoral and PhD students


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IMDEA-Nanociencia is recruiting highly motivated individuals to contribute to this phase of active growth. Applications are invited for senior level scientists (tenured position), junior researches (tenure track position) in the followings areas:

Senior Scientist in
- Synthesis of Organic Functional Materials
- Biosensors
- Fabrication and Properties of Nanostructures
- Modelling Physical Properties of Nanostructures

Scientist in
- Spin Polarized STM
- Photoelectron Microscopy
- Force Spectroscopy on Biosystems

Research Fellow (4-years tenure track positions) in
- Synthesis of Semiconducting Organic Polymers
- Conductive AFM
- First Principles Theoretical Modelling
- Optical Tweezers Manipulation of Biological Nanomachines
- Transport Properties of Nanostructures
- Nanolithography
- Advanced Microscopy
- Growth of Thin Organic Films and Devices

To learn more about IMDEA-Nanociencia International Call for Research Positions 2009, please visit: **www.nanociencia.imdea.org**
To apply, please upload your application at:
www.imdea.org/internationalcall/Default.aspx?idInstitute=24

The deadline for applications is July 30th, 2009

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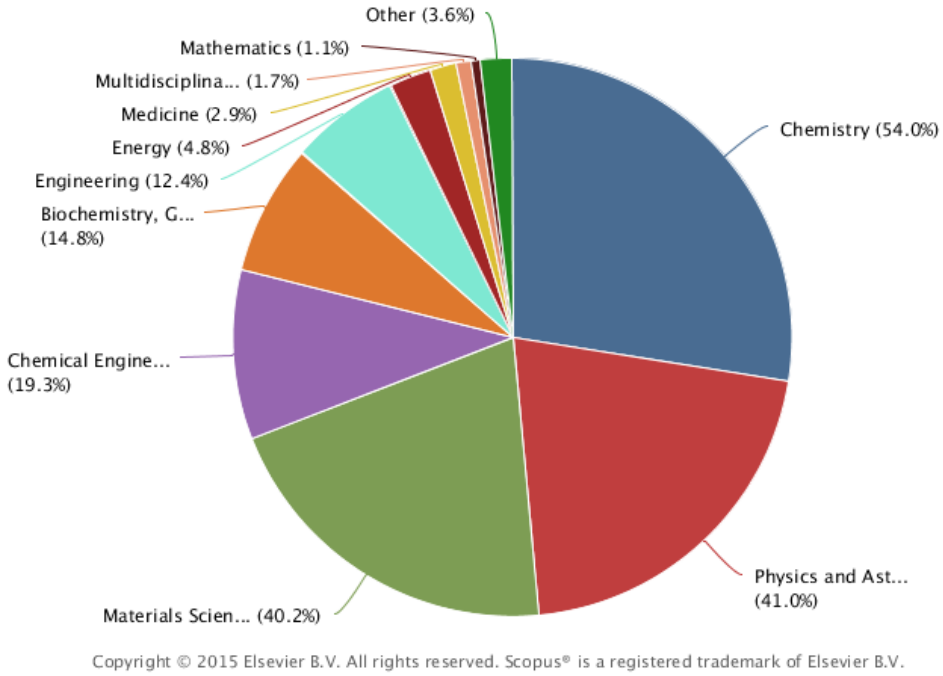
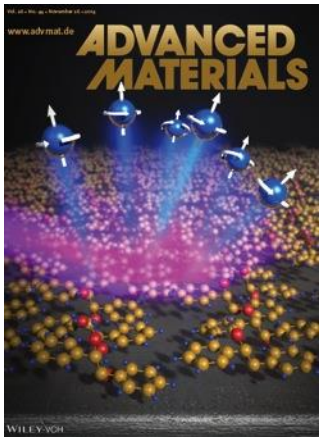
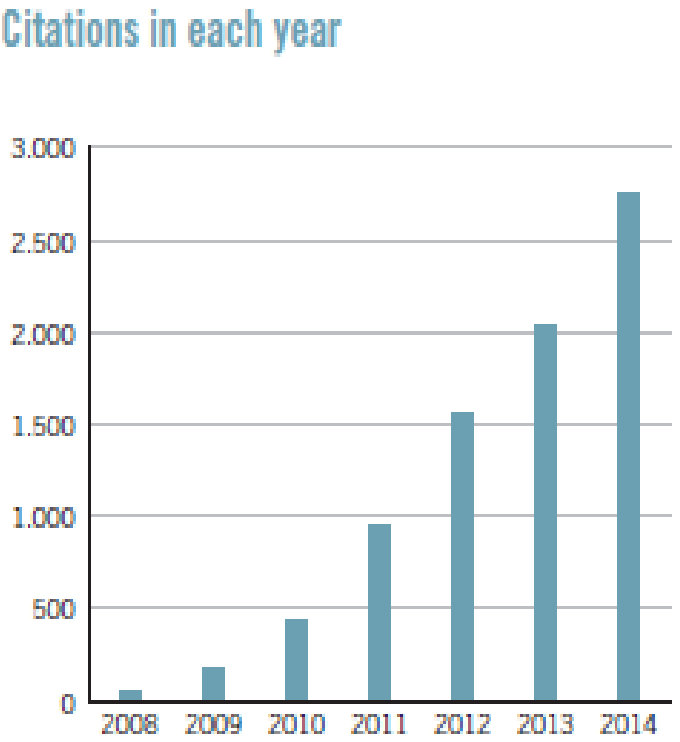
Publications in ISI Journals (2008-2014)

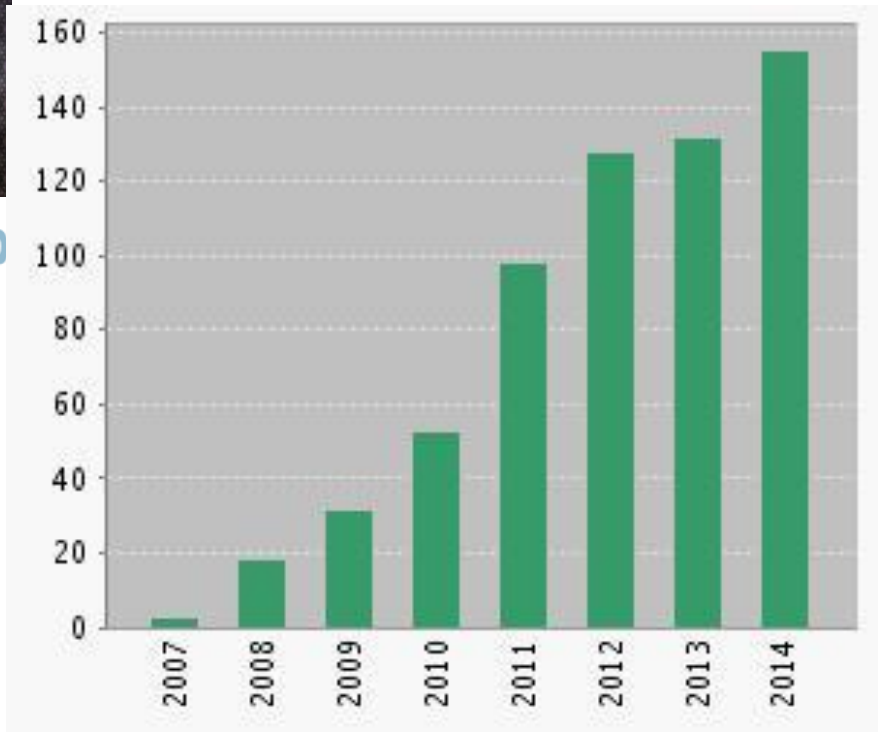


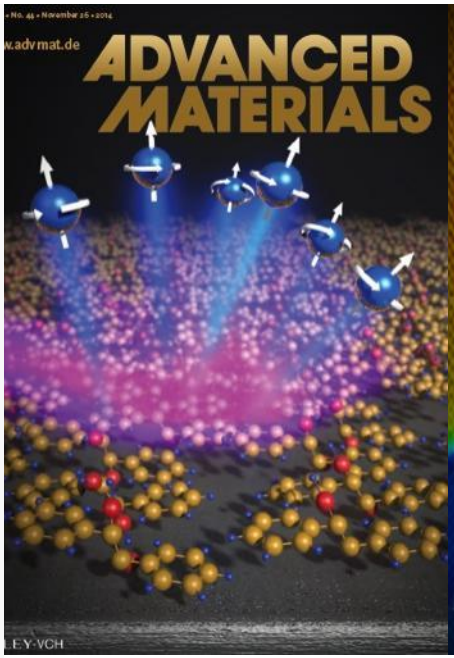


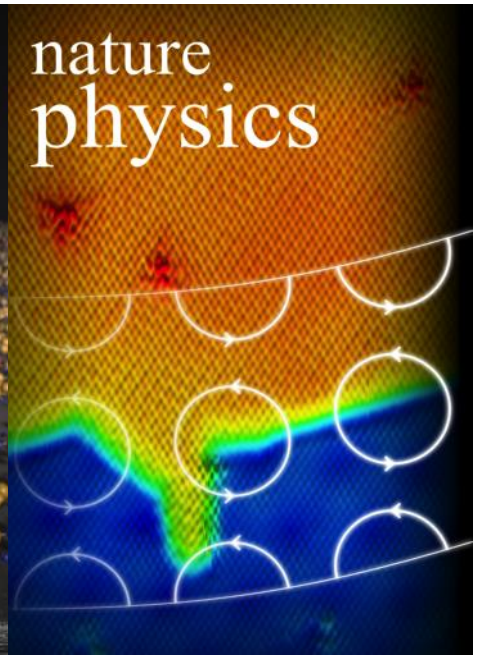


- Sum of the Times Cited : 8677
- Average citation per item: 13.00
- Institutional H index: 44

Publications (2008-2014)







More than 600 (619)
134 in 2013 and 150* in 2014

including, Chemical Reviews, Nanoscale, Nature Physics, Advanced Materials, JACS, Nature Communications, Angewandte Chemie, PNAS, Nanoletters, Advanced Functional Materials, APL,)

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European Projects

- **Marie Curie Actions**
  - Nanomatch (RTN).
  - Biomore (RTN).
  - Establis (ITN)
  - Dotube (ERG).
  - Bionanotools (IRG).
  - Nanotest (IOF).
  - Pocaontas (ITN)*
  - Onda (IRSES)
  - Amarout I and II EUROPE.
  - SolarRevolution (IEF).
  - ImaginDNA (CIG)
  - Metallodrugs against cancer (CIG) (COFUND).

*IMDEA as coordinator

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European Projects

- **FP7 Research Consortium**
  - Multifun (Large)
  - NanoPyme*
  - PHOCS
  - Nanoleap (H2020)
- **ERC Actions (ERC)**
  - MINT (StG)
- **COST Actions (ESF)**
  - Chemistry with Ultrashort Pulses* and XLIC *
  - NanoSpectrocopy and NanoFriction
- **CSC Actions (China)**
  - Multilevel magnetic recording organic position sensitive photodetectors

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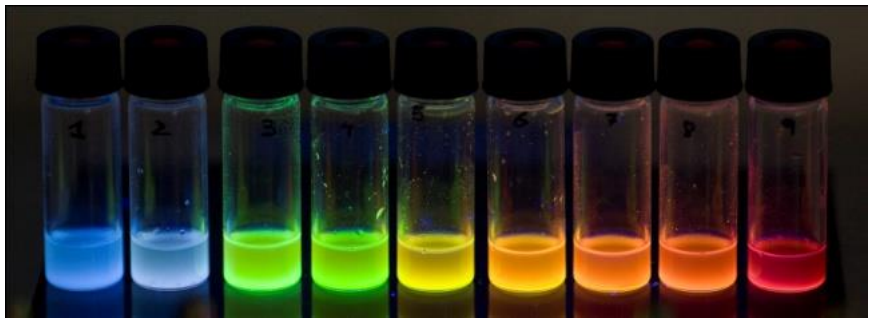
Patents

1. P201530126 GRAFENO COVALENTEMENTE MODIFICADO
2. WO2015116502 (A1) DETECTION AND TREATMENT OF GNAQ MUTAN...
3. ES2538604 (A1) PRODUCTION OF CORRUGATED AND POROUS G...
4. WO2015114127 (A1) FUNCTIONALIZED METAL NANOPARTICLES AN...
5. WO2015015035 (A1) METHOD FOR THE SYNTHESIS OF COVALENT ...
6. WO2015014862 (A1) GRAPHENE DRIED POWDER AND METHOD FOR ...
7. WO2014177533 (A1) MODIFIED SOLID SUPPORT FOR THE SYNTHE...
8. ES2384766 (A1) POSITION-SENSITIVE PHOTODETECTOR, MET...
9. EP2650939 (A1) POSITION-SENSITIVE PHOTODETECTOR, MET...



Patents

1. **Position Sensitive Photodetector**: Spain's Patent Office (FULLY REGISTRED) - 50% ownership with CSIC. PCT Extended to Europe, EE.UU. and Japan.

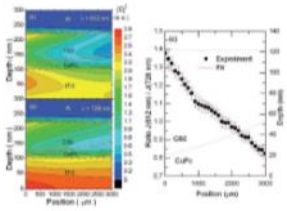
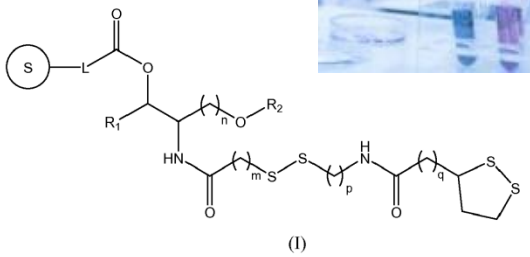


Figure. (Left) Optical modelling of the in-depth distribution of light across a multilayer photodetector. (Right) Dependence of photocurrent as a function of position.

2. **Solid Support for Oligonucleotide Synthesis**: Registered at European Patenet Office EPO – PCT Extension 100% IMDEA



(I)

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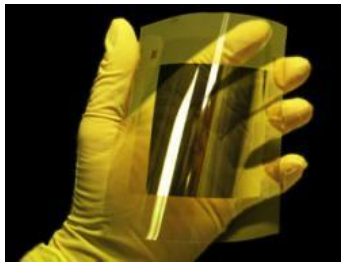
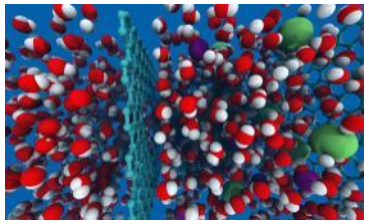
Patents

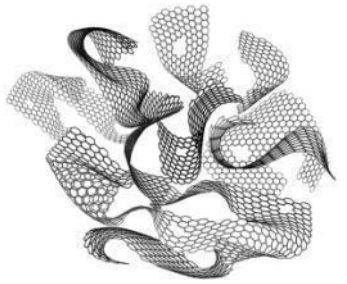
3. **New Method for the Sintesis of Graphene Inks:** EPO; IMDEA 25%, UAM 25%, Abengoa Research 50%
   - Pre-Comercial Licence Agreement with Abengoa Research



4. **COF Covalent Organic Frameworks:** Patente Europea EPO; IMDEA 50%, UAM 40% y la UCM 10%



5. **Preparation of Corrugated and Porous Graphene using COFs for its use as Supercapacitors:** OEPM; UVEG 70%, UAM 17,5%, IMDEA 12,5%



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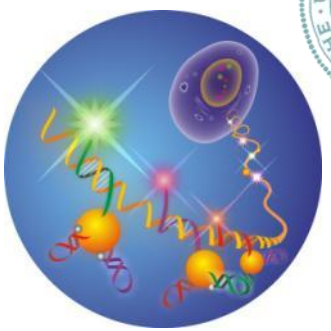
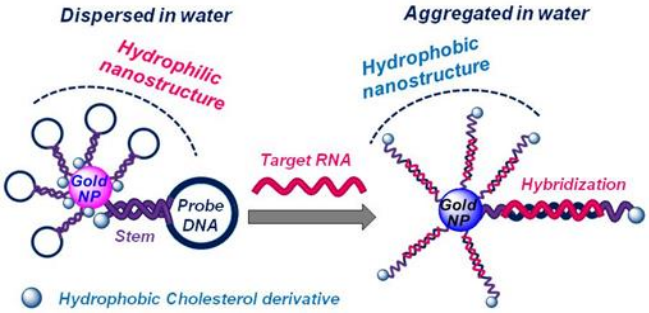
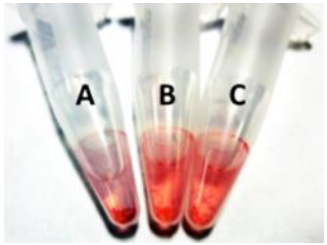
Patents

6. **Single-Point Mutation Detection in RNA Extracts using Gold Nanoparticles Modified with Hydrophobic Molecular Beacons**:EPO patent filed at OEPM IMDEA 60%, University of California at San Francisco 40%, Interintitutional Co-ownership agreement



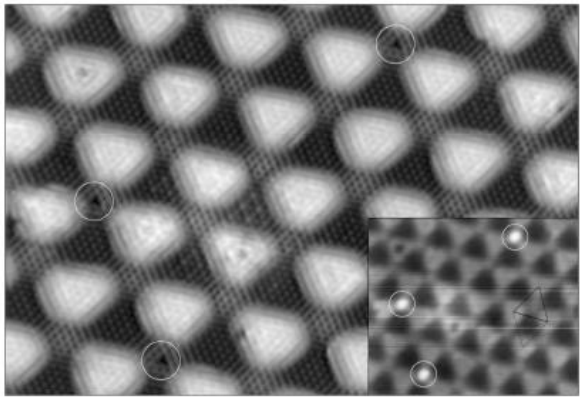
7. **Detection and treatment of GNAQ mutant uveal melanoma cells with metallic nanoparticles:** USA patent file at USPO: IMDEA 40%, University of California at San Francisco 40%, Interintitutional Co-ownership agreement

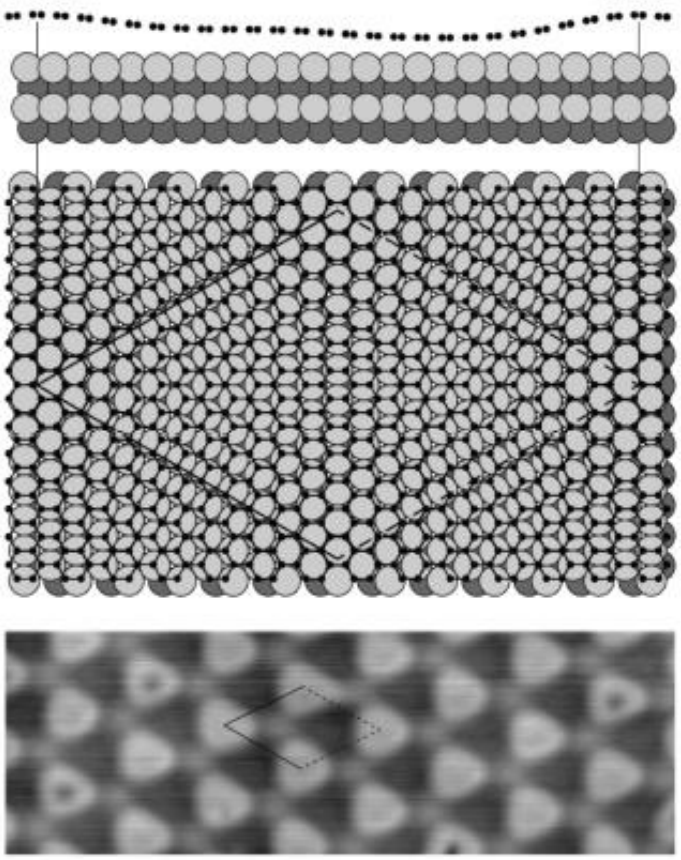




Patents

6. **Covalent Modified Graphene:** solicitud presentada en la OEPM el 2/2/2015. Recepción muy rápida de resultados del IET. Vencimiento año de prioridad: 02/02/2016





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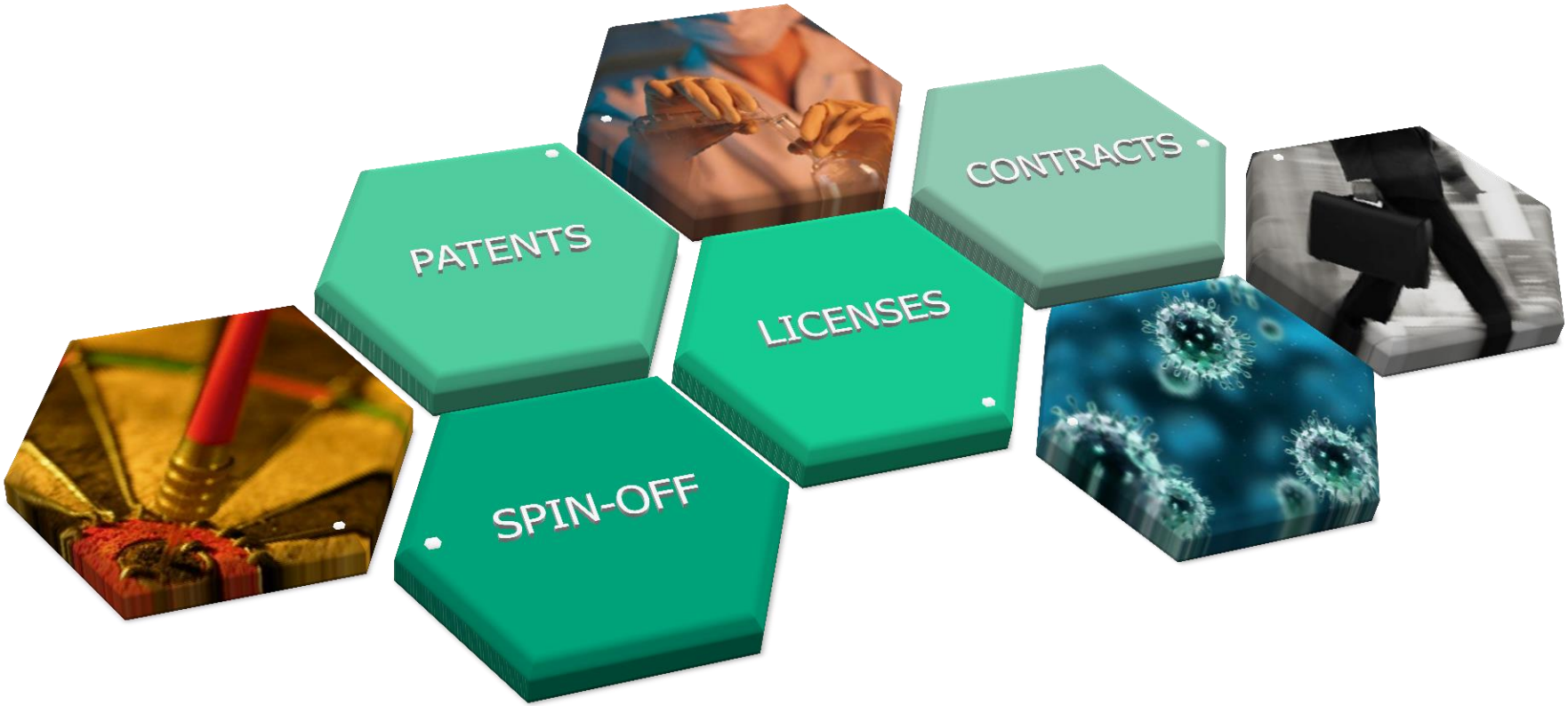
Tech Transfer



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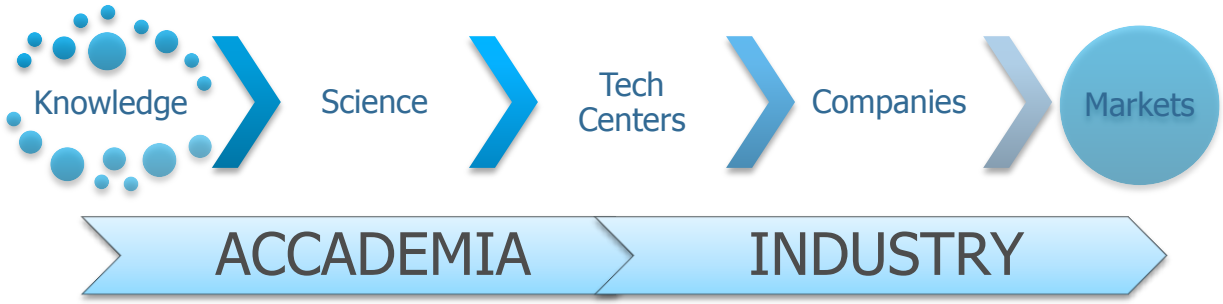
Tech Transfer

- Science and business of excellence share a common goal: to be on the very top.
- Partnership at the frontier of knowledge and markets
- Mid term state of the art projects
- Good Science for solving fundamental problems and generating new paradigms



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Gas & Oil Sector

The Challenge: Explosion in energy demand

The Opportunity: Nanotechnology for Energy Applications

The Revolution: Nanoscience

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Massachusetts Institute of Technology

REPSOL

Short term
< 5 years

Medium term
5 - 15 years

Long term
> 15 years

Nanotechnology roadmap

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Gas & Oil Sector

- Cambridge TRM Methodology
- 6 Areas of Application
- 24 Expert panel meetings
- Collaborative Intranet
- 1 year project

- Baterías – Almacenamiento de Energía
- Nanocatalizadores
- Nanomateriales – Sistemas funcionales
- NOX – Emisiones de vehículos
- PV
- Upstream – Nanosensores

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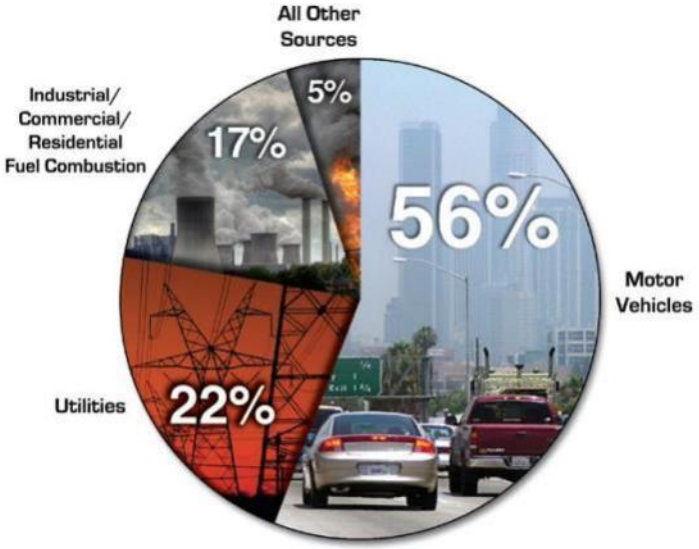
Gas & Oil Sector

NOX EMISSIONS CONTROL WITH FERROELECTRIC CATALYSIS

Direct R&D Contract: 130.000 € in 2015



Sources of Anthropogenic NOx

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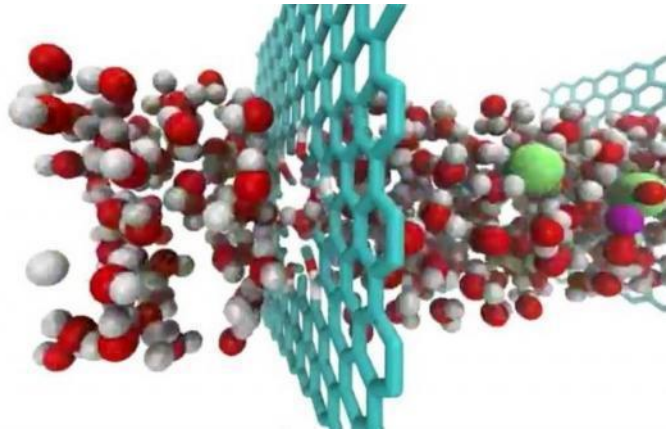
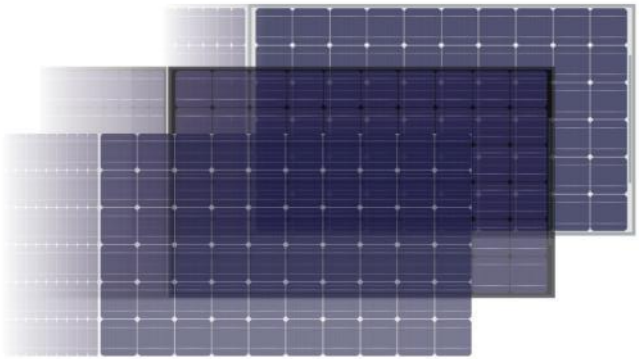
Energy & Environment Sector

- Conductive Graphene Ink for PV Applications
- Covalent Organic Frameworks for Water Desalinization

ABENGOA RESEARCH





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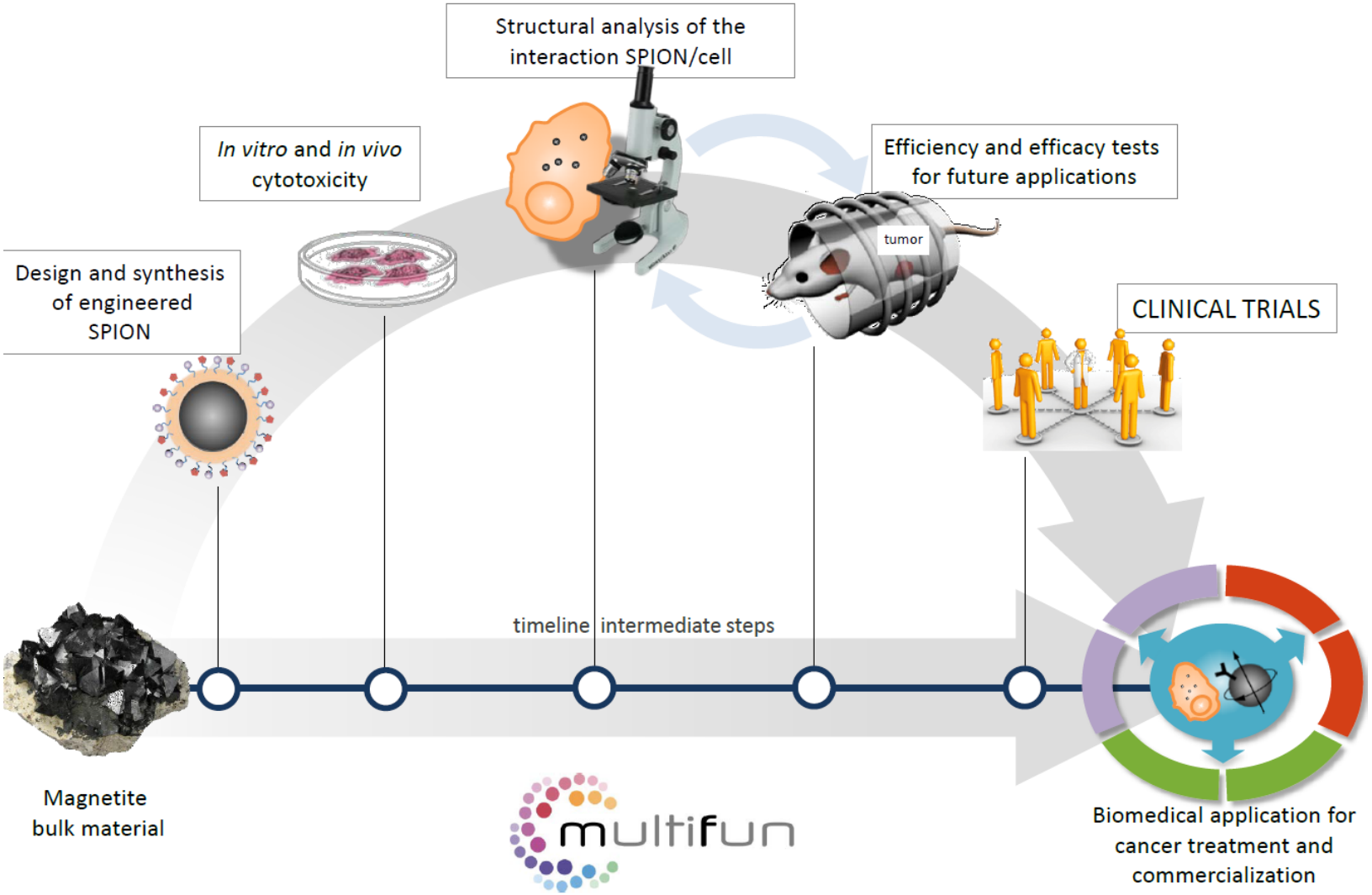
Nanomedicine



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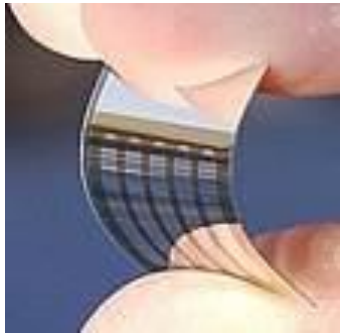
Energy & Environment Sector

POCAONTAS

- Scope: Increasing the lifetime of organic solar cells to reach potential mass markets like photovoltaic windows for office buildings
- Method: Understand influence of nano morphology on degradation processes, test various approaches to suppress degradation
- Role of IMDEA Nanociencia:
  - Time-resolved spectroscopy from femtoseconds to seconds at working solar cells
  - Combined with optoelectronic device characterization



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Construction Sector

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acciona

NANO LEAP

netcomposites

PURINOVA

CAMBRIDGE NANOMATERIALS TECHNOLOGY LTD

INEA

SEPAREX

Stam industrial research

graphenano "nanotechnologies"

nanto cleantech SINGULARITY MATERIALS

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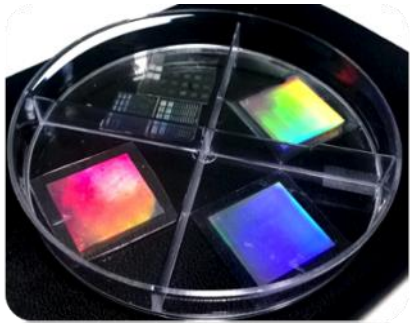
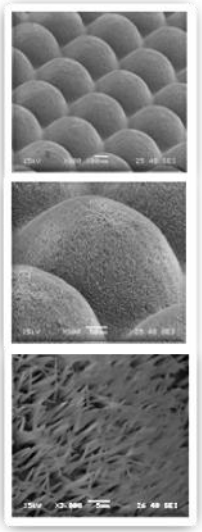
Cosntruction Sector

Nanocomposites for building constructions and civil infrastructures



- European network pilot production line to promote industrial application cases.
- NMP1-01-2014 Open Access Pilot Plants for cost effective nanocomposites: **6.9 M€**
- **Number of Associates**: 16 including public research centers and companies



IMDEA Work package: Roll to roll fabrication of multifunctional polymer composite films via nanoimprint technology. Targeted Functions: Superhydrophobic , anti-reflective, self-cleaning

EU Grant for IMDEA Nanoscience: 750.000 €

Objective: Design, build and run a nanoimprinting roll-to-roll pilot plan that European companies may use to print their prototypes

Principal Investigator: Isabel Rodriguez

- **Special collaboration:** Fraunhofer Institute for Manufacturing Technology and Advanced Materials

Fraunhofer IFAM

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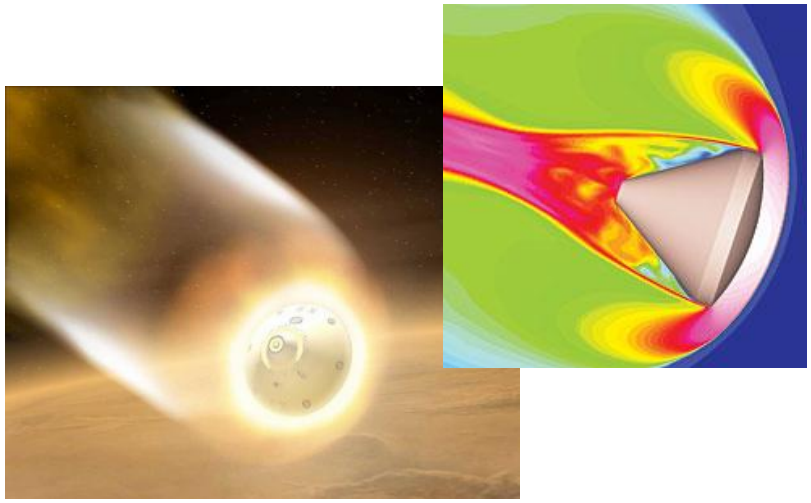
Aerospace

- Graphene Surface in Thermal Shields
- MINECO Innpronta call funding
- Project PERIGEO
  - Atmospheric reentry applications
  - Multilayer graphene growth
  - Plasma chambre trial

deimos SPACE

AERnnova



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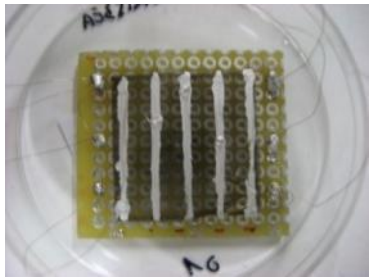
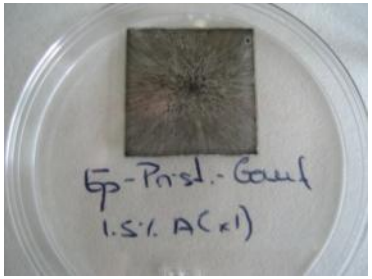
Aeroespace

AIRBUS

Functionalized Nanocomposite Materials

- ICARO Conductive Compistes (Cenit)
- Consortium lead by Airbus Spain
- R&D Contract with Aernnova: Conductivity functionality





12 Socios

AIRBUS

AERnnova IDEC GrupoTAM

EADS Astrium Applus Ingenieros sisteplant

EADS CASA Indra LOXIN aries COMPLEX, S.A.

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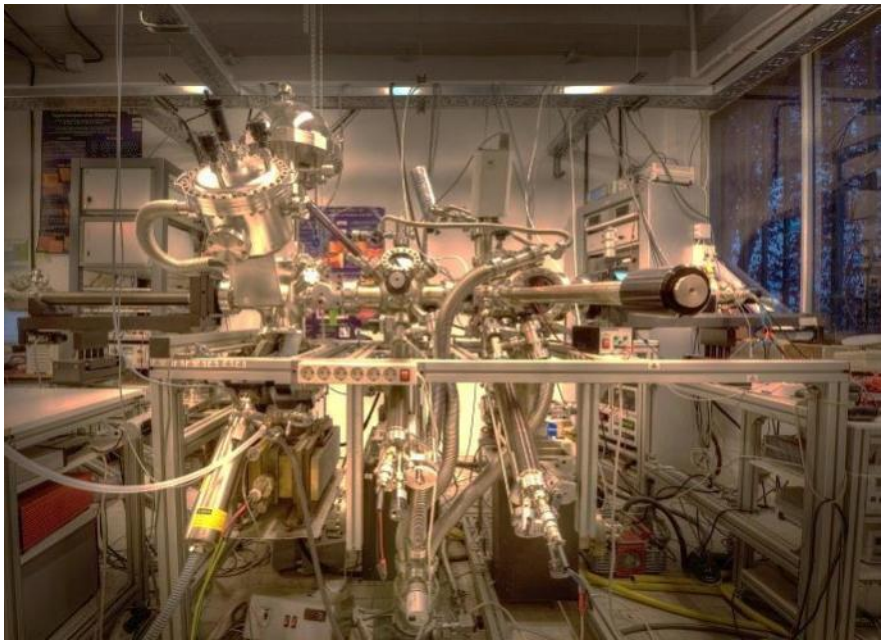
What we offer

- Ph.D. Joint Programme with UAM and UCM
- Advanced training in Nanoscience Research Technics
- Post Doc stages
- H2020 Collaboration
- Bilateral Collaboration



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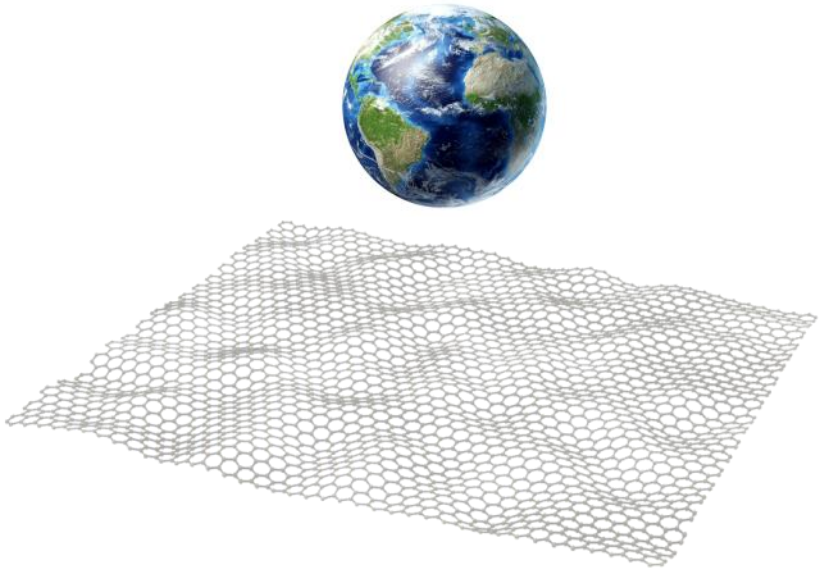
Graphene Worldwide

Country	N
China	15716
United States	10242
South Korea	3830
Japan	2750
Germany	2466
India	2079
United Kingdom	1823
Singapore	1688
France	1408
Spain	1298
Italy	1262
Russian Federation	1240



- Scopus, search term “Graphene” (Article, Title, Abstract, Keywords)
- Document Type: All, Year:2010-2015
- Total Documents: 45992

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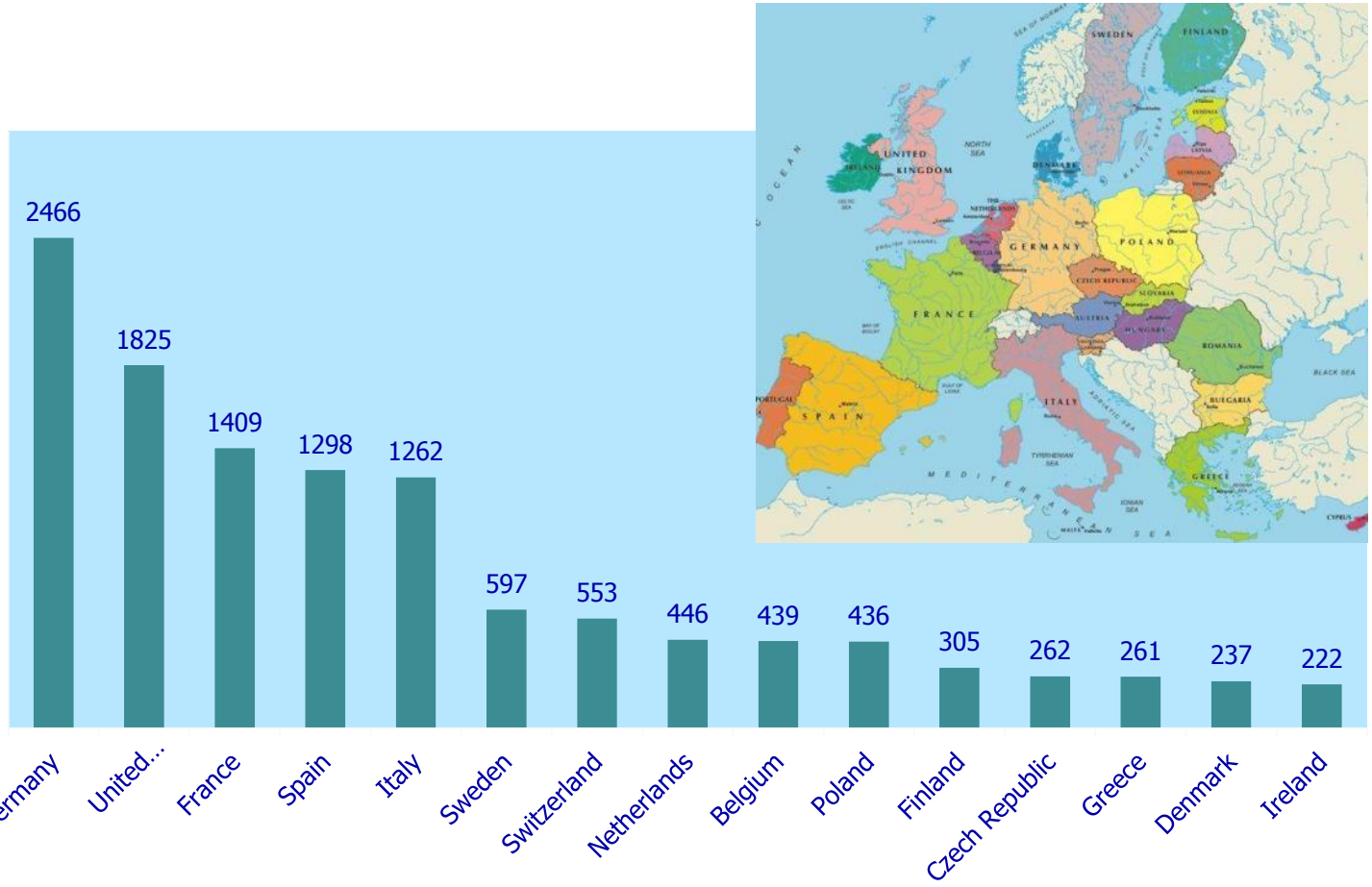
Graphene Worldwide

AUTHOR	# Articles	% Articles	Country	#Articles by country
Ruoff, R.S.	167	1,88	USA	8896
Peeters, F.M.	143	36,29	Belgium	394
Novoselov, K.S.	142	1,60	United Kingdom	8896
Katsnelson, M.I.	139	29,83	Netherlands	466
Guinea, F.	125	11,11	Spain	1125
Otsuji, T.	117	4,63	Japan	2529
Geim, A.K.	112	1,26	United Kingdom	8896
Ryzhii, V.	108	4,27	Japan	2529
Castro Neto, A.H.	102	7,71	Singapore	1323
Tour, J.M.	100	1,12	USA	8896

Top 10 most productive authors with respect to the number of articles dealing with graphene at world level. The percentages are calculated over the total output by the country of authors

Source: SCImago Group from Scopus data

Graphene in Europe



Europe defined as EU member states 28 +Switzerland + Norway

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Graphene in Europe

EUROPEAN GRAPHENE RESEARCH CLUSTERS	No. Pub
London	699
Madrid	460
Manchester	376
Berlin	287
Paris	283

Top 5 Graphene Research Clusters in Europe. Size calculated by aggregating output of scientific articles published in top quartile peer reviewed academic periodicals on the subject of graphene. Each cluster is composed of at least 3 institutions of affiliation within a 100 km range of city center. Data: SCOPUS.

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Graphene Patents

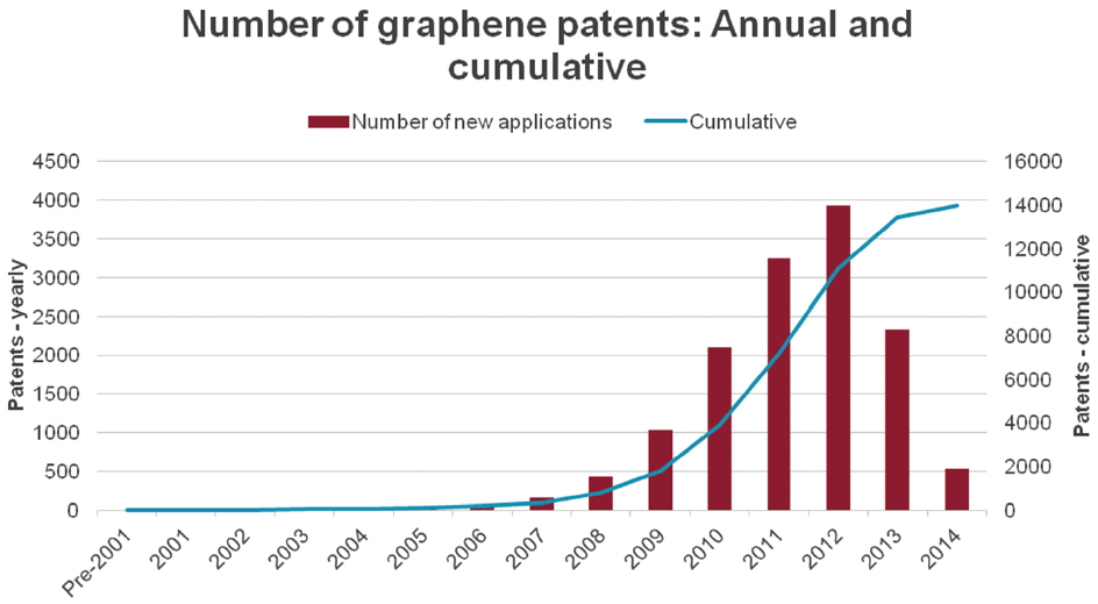

Fig. 11 Patent applications on graphene as a function of application year. Note: patents remain unpublished for up to 18 months from their filing. Accordingly, 2013 and 2014 are under-represented. Data updated as of July 2014.

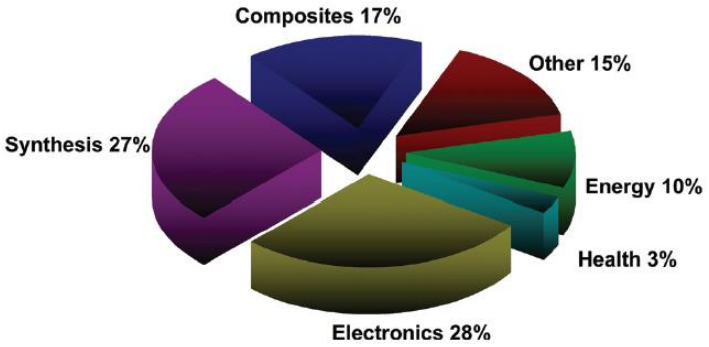

Fig. 12 Proportion of overall graphene patents, by sector as of July 2014.

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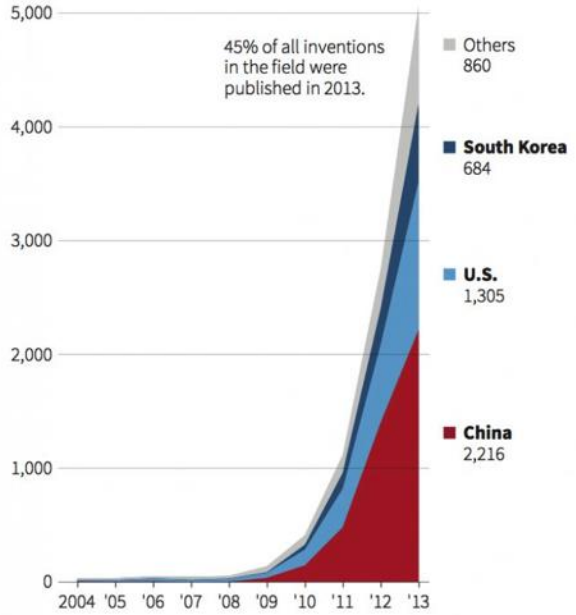
Graphene Patents

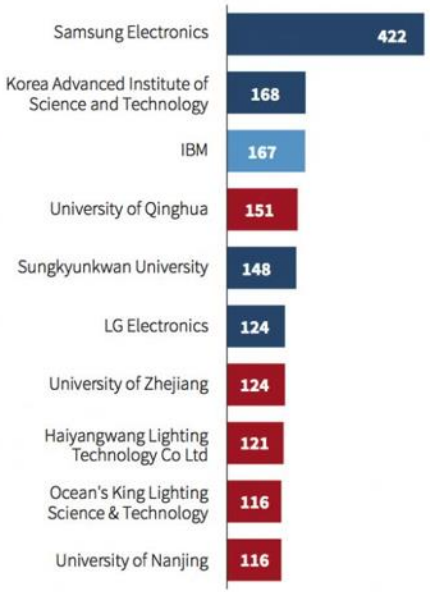
Graphene patents

Analysis of inventions involving the manufacture or application of graphene shows dramatic growth over the last decade from just 33 inventions described in published patents in 2004 to over 5,000 inventions last year

Countries with the most graphene inventions



Top ten companies/institutions with the most patents



- Graphene, a one-atom thick layer of graphite, is stronger and harder than diamond, yet can be stretched by a quarter of its length like rubber.
- First mentioned in a study in 1987, it was isolated in a stable free form in Manchester, England in 2004.
- Graphene inventions apply to technologies such as touch screen displays, lithium ion batteries, fuel cells, mobile phones, LED displays, and electronic components in general.

Source: Reuters

C. Inton, 29/04/2014

REUTERS

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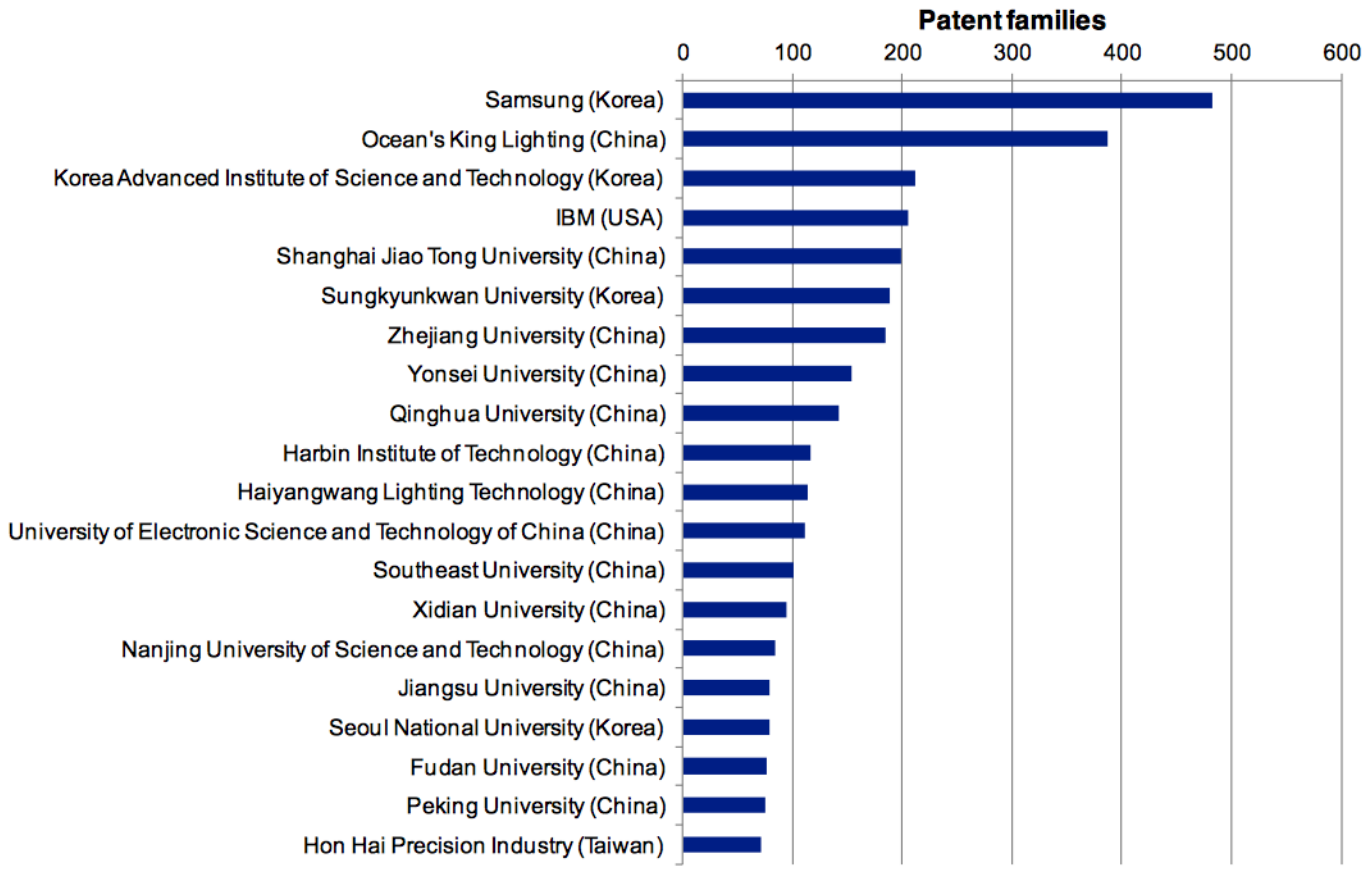
Graphene Patents



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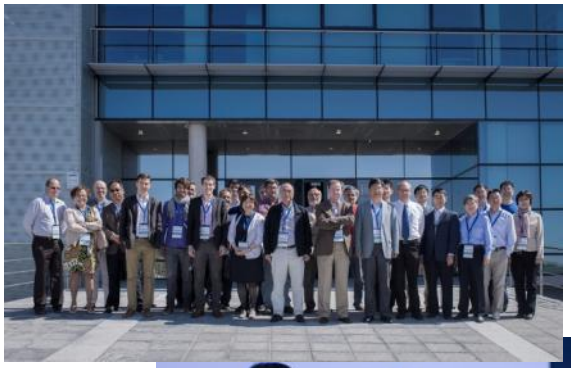
Cooperation with China

- 1st Sino-European Graphene Research Summit
  - May 2012, Beijing
- **2nd Sino-European Graphene Research Summit**
  - May 2014, Madrid
  - Organized by IMDEA Nanoscience and Centre for Nanotechnology at Peking University



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