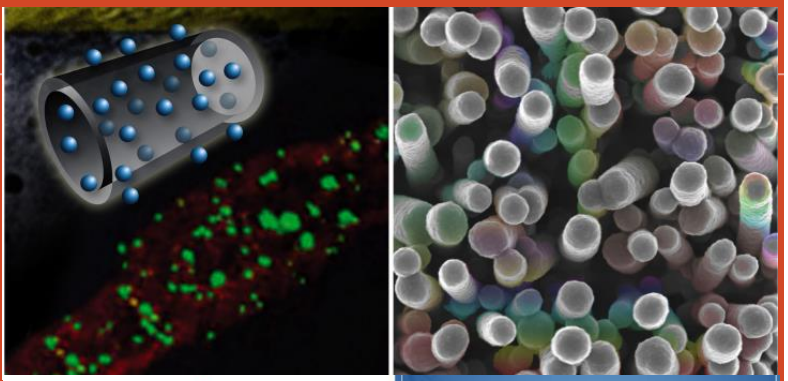
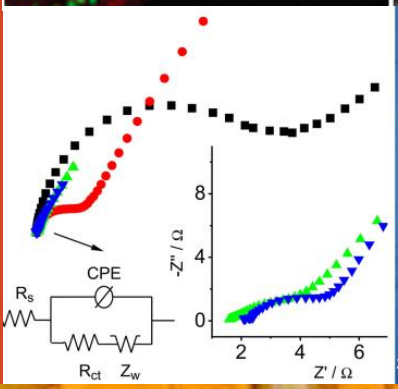
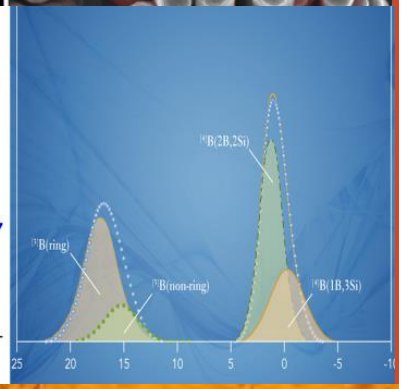
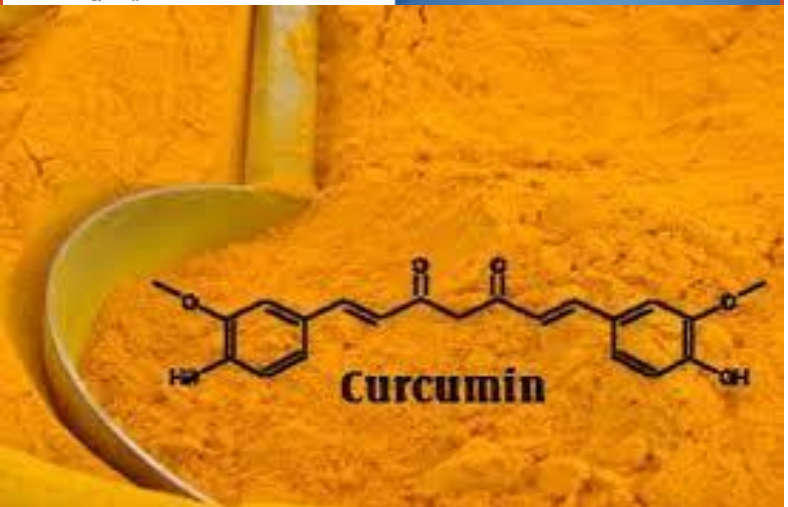
Kuala Lumpur, 2-4 May 2017









UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

APCTT
Asian and Pacific Centre for Transfer of Technology

Current status of nanotechnology development in Vietnam

Tran Dai Lam

Vietnam Academy of Science and Technology

VAST

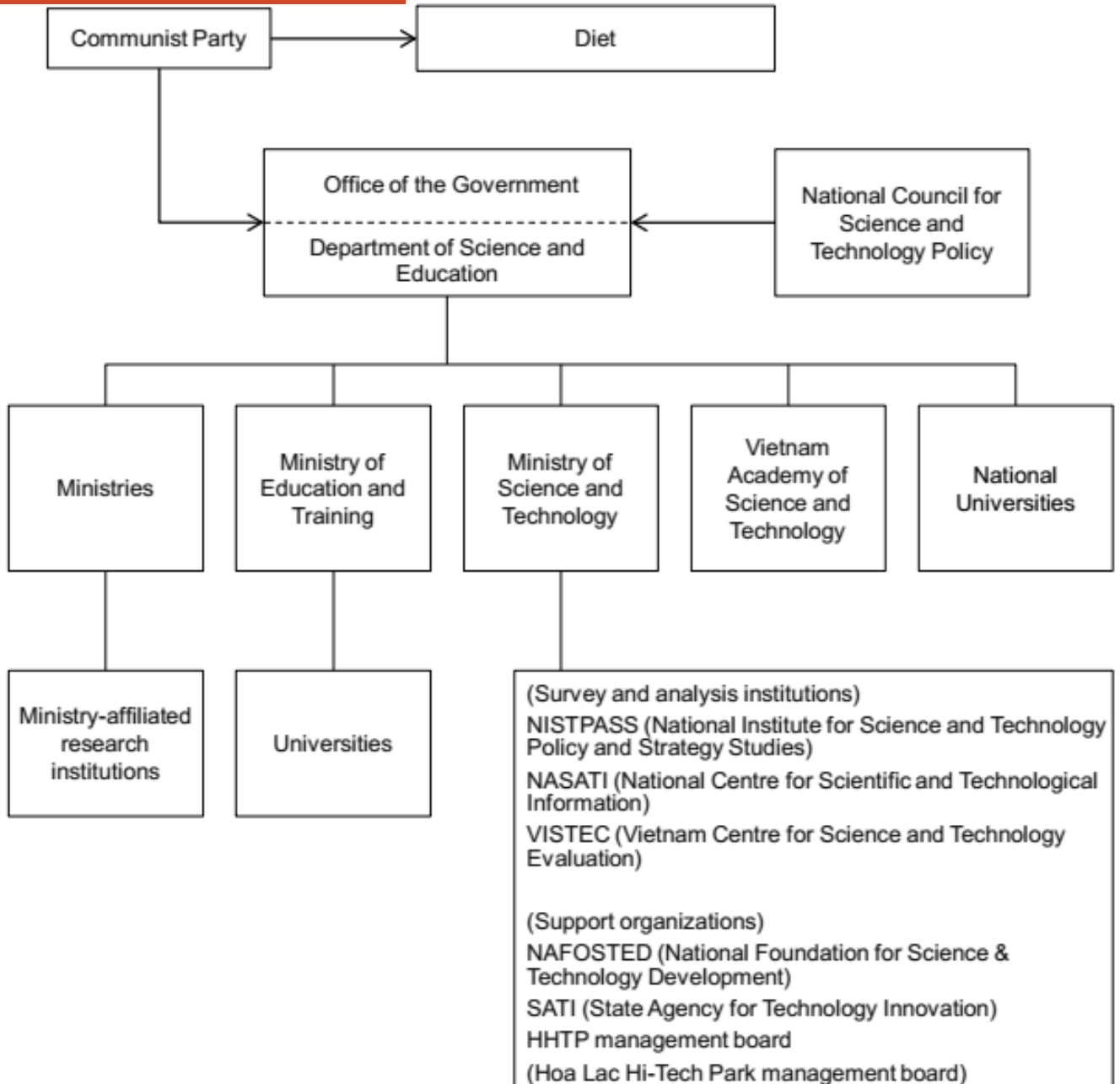
Executive Committee Member of ANF

ANF
Asia Nano Forum

Geographic location

332,698 km2
92,700,000 people
(14th)

Governmental S and T chart



Research Institutions and Univs.

VAST

The Vietnam Academy of Science and Technology

ĐHQGHN

Since 1906
VNU
ĐẠI HỌC QUỐC GIA HÀ NỘI
Vietnam National University, Hanoi

ĐẠI HỌC KHOA HỌC TỰ NHIÊN

ĐẠI HỌC CÔNG NGHỆ

ĐẠI HỌC QUỐC GIA
THÀNH PHỐ HỒ CHÍ MINH

iNT

Vietnam National University - Ho Chi Minh City (VNUHCM)
Institute for Nanotechnology (INT)

ĐẠI HỌC
BÁCH KHOA

TRƯỜNG ĐẠI HỌC BÁCH KHOA HÀ NỘI
HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Vietnam Academy of Science and Technology (1)

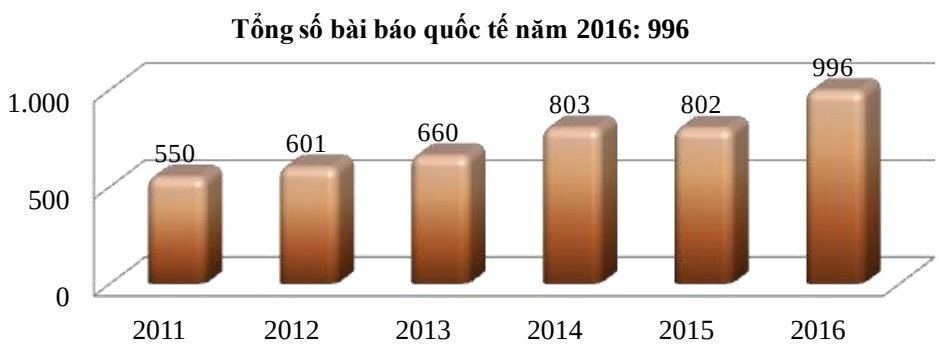
- The largest and most prominent research institute in Vietnam.
- Founded in 1975 as the **Vietnam Academy of Science**, and renamed the Vietnam Academy of Science and Technology (**VAST**) in 2008.
- Its infrastructure spans Hanoi, Ho Chi Minh City, Hải Phòng, Nha Trang, Đà Lạt, and Huế.

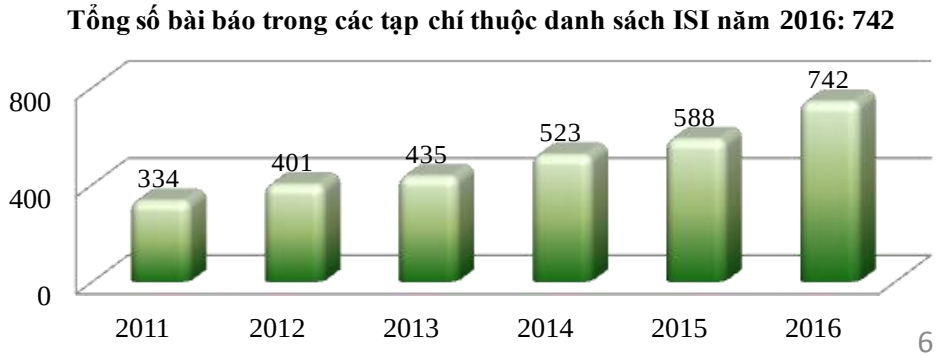
Institute of Mathematics
Institute of Physics
Institute of Chemistry
Institute of Mechanics
Institute of Geology
Institute of Materials Science
Institute of Biotechnology
Institute of Tropical Technology
Institute of Applied Mechanics
Institute of Natural Product Chemistry
Institute of Environmental Technology
Graduate University of Science and Technology
University of Science and Technology of Hanoi
High-Tech Development Center
…

Vietnam Academy of Science and Technology (2)

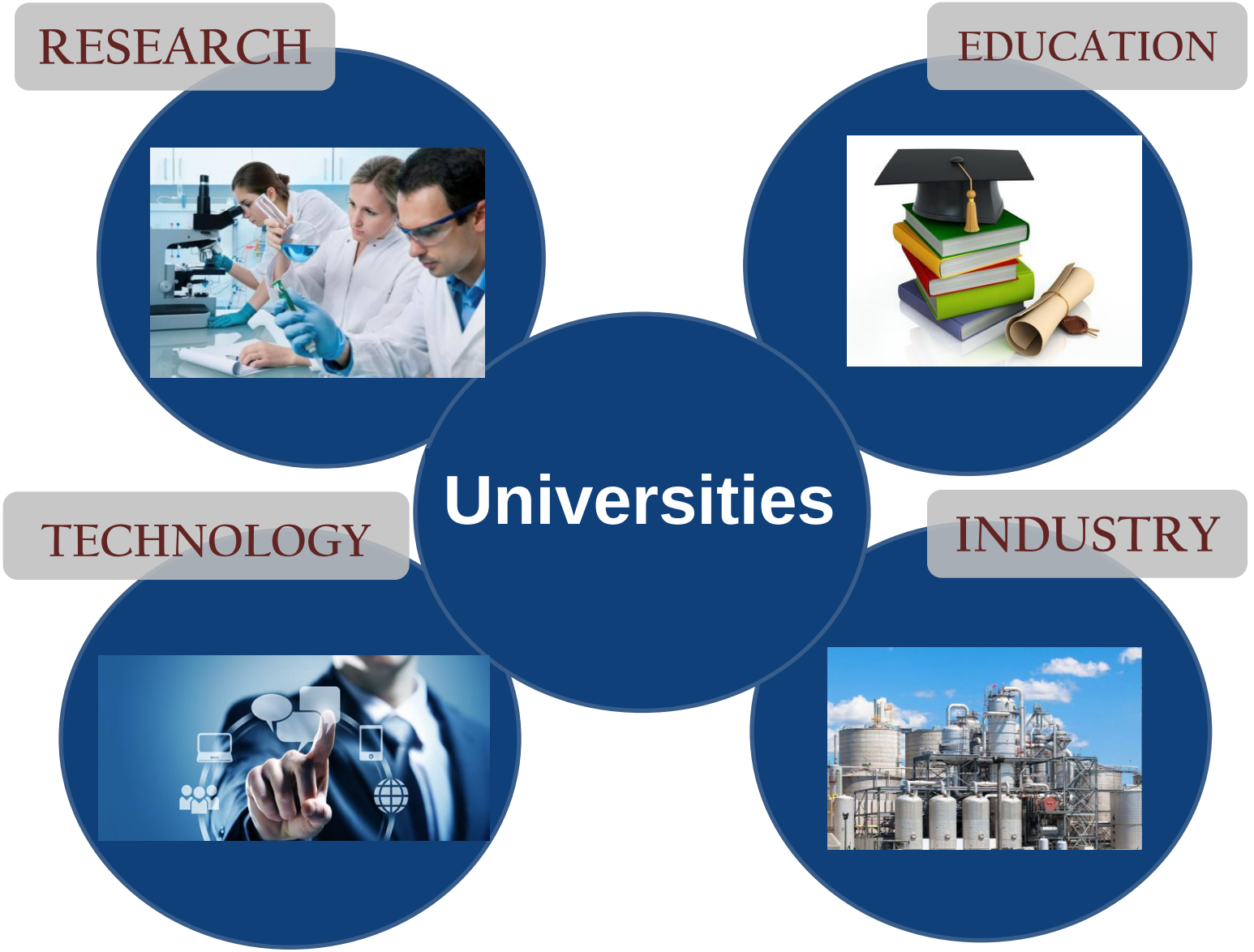
Number of scientific papers, patents 2011-2016

TT	Nội dung	2011	2012	2013	2014	2015	2016
A	Tổng số các công trình khoa học *(1+2+3+4+5)*	1.612	1.698	2.298	2.074	2.197	2.007
B	Số lượng bài báo đạt chuẩn quốc tế *(1+2+3+4)*	550	601	660	803	802	996
C	Số lượng bài báo trong các tạp chí thuộc danh sách ISI *(1+2)*	334	401	435	523	588	742
1	Số lượng bài báo trong tạp chí thuộc danh sách SCI	209	258	282	298	317	387
2	Số lượng bài báo trong tạp chí thuộc danh sách SCI-E	125	143	153	225	271	355
3	Số lượng bài báo trong tạp chí có mã số quốc tế ISSN/ISBN *(năm 2016 chỉ tính số lượng bài báo cho tạp chí có ISSN)*	216	200	225	246	176	248
4	Số lượng bài báo đăng trên 3 tạp chí đạt chuẩn quốc tế của Viện Hàn lâm (VAST SCOPUS)				34	38	6
5	Số lượng bài báo trên các tạp chí quốc gia	1.062	1.097	1.638	1.271	1.395	1.011
6	Số lượng bằng phát minh sáng chế	7	7	7	3	11	11
7	Số lượng giải pháp hữu ích	4	5	6	10	7	17





Research oriented university inside VAST



Graduate University of Science & Technology

--- Result of a merging 19 graduate units inside of VAST

--- Public university under the direct supervision of Vietnam Academy of Science and Technology and the Ministry of Education and Training

--- Research-based, interdisciplinary oriented

-MSc
-PhD

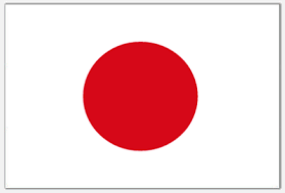
-BSc

Science + Engineering
1. School of Mechanical Engineering and Automation
2. School of Materials Science and Energy Engineering
3. School of Information Technology and Telecommunication
4. School of Mathematics
5. School of Ecology, Biological Resources and Environmental Engineering
6. School of Chemistry
7. School of Physics
8. School of Life Science and Biotechnology
9. School of Geography
10. School of Earth sciences
11. School of Marine Science and Technology

Model of Graduate University in Asia

中国科学院大学
University of Chinese Academy of Sciences

National University
SOKENDAI
The Graduate University for Advanced Studies



UST
과학기술연합대학원대학교
UNIVERSITY OF SCIENCE & TECHNOLOGY

University of Science and Technology of Ha Noi (France Vietnam University)






Primary Address
18 Hoang Quoc Viet,
Cau Giay Districtt,
10000, Ha Noi, Viet Nam

Website: http://www.usth.edu.vn
Phone: +84-4 37 91 69 60
E-mail: officeusth@usth.edu.vn

Where your future starts

- BSc

USTH:

- Established by VN-FR agreement in 2009
- Located in Ha Noi, Viet Nam
- One of the excellent universities in VN
- Enrolled more than 500 students/year

What makes USTH look different?

- Research – education – Industry linkages
- Innovative thematic departments
- International concepts and standards
- Students' autonomy
- Bologna process (3-5-8) (French system)

“Nano” in BSc, MSc and PhD programs

- **B.Sc. degree** *(Chemistry, Engineering Physics, Materials Science)*
- **M.Sc. degree** *(Nano Materials and Devices, Nano technology, Nano-Biotechnology, Chemistry, Physic)*
- **Ph.D. degree** *(Chemistry, Physics, Materials Science)*

University of Science and Technology of Hanoi (USTH)

Graduate University of Science and Technology (GUST)

Hanoi University of Science and Technology (HUST)

Vietnam National University, Hanoi

Vietnam Japan University *VNU since 1906*

Hue University

The University of Danang

NanoTech for Energy, Environment, Sensors and Biomedical and Smart materials is a priority

Viet Nam National University Ho Chi Minh City (VNUHCM)

Cantho University

Vietnam National University- Ha Noi (1)

- VNU University of Science
- VNU University of Social Sciences and Humanities
- VNU University of Languages and International Studies
- VNU University Engineering and Technology
- VNU University of Economics
- VNU University of Education
- VNU Vietnam - Japan University

Vietnam National University- Ha Noi (2)

Univ. of Engineering & Technology
Micro-Nano Lab

Hanoi Univ. of Science
Nano and Energy Center

Micro-nanostructured functional magnetic materials: magneto-strictive, magneto-resistive, spin-valve materials, multiferroics, magnetic nano particles… Application studies include: magnetic field sensors, stress sensors, biosensors and biochips for biomedical applications etc.

Micro-nanostructured semiconducting materials: photo-electrochemical materials, polymer-based hybrid materials. Application studies include: organic light emitting diodes (OLED), rechargeable batteries, solar cells, etc.

Micro-nanostructured functional ferroelectric materials: nano-particles, thin films and composites, MEMS design, fabrication and applications.

Computational Physics, modeling and simulation of micro-nano materials and devices.

Vietnam National University- Ho Chi Minh

University of Technology

UNIVERSITY OF SCIENCE

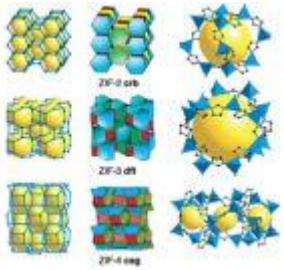
VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY

Vietnam National University - Ho Chi Minh City (VNUHCM)

Institute for Nanotechnology (INT)

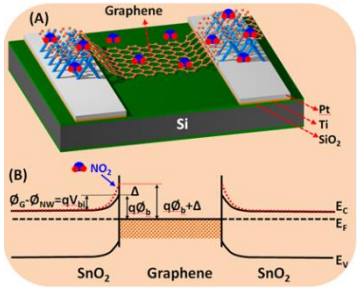
CENTER FOR MOLECULAR AND NANOARCHITECTURE

Omar M. Yaghi
Department of Chemistry & Biochemistry,
UCLA



Hanoi University of Science and Technlogy (Polytechnic)

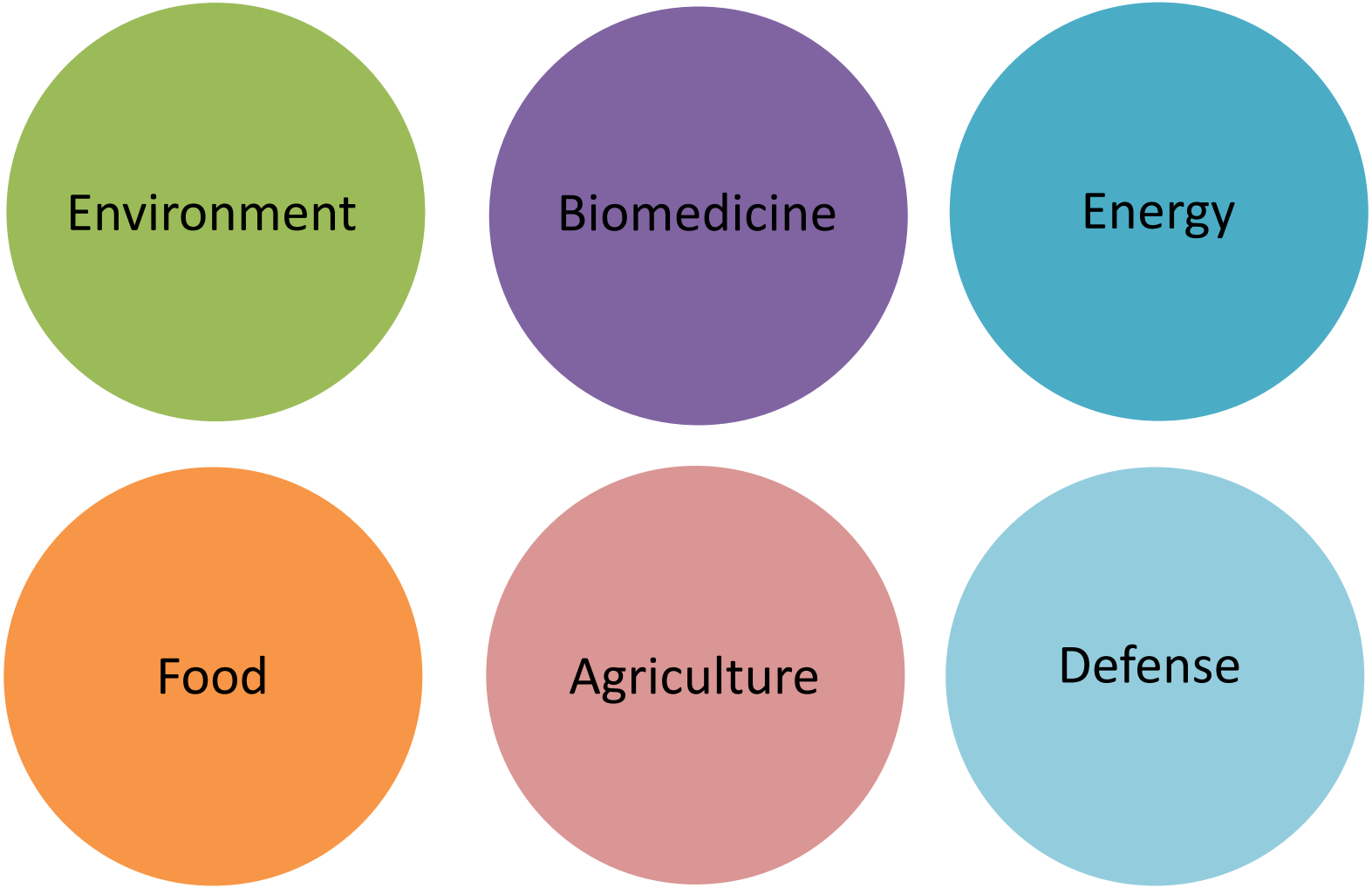
VIỆN ĐÀO TẠO QUỐC TẾ VỀ KHOA HỌC VẬT LIỆU
INTERNATIONAL TRAINING INSTITUTE FOR MATERIALS SCIENCE (ITIMS)
TRƯỜNG ĐẠI HỌC BÁCH KHOA HÀ NỘI



Research Fields

Micro-Electrochemical Systems (MEMS)
Gas Sensors
Biosensors
Photoelectronic materials
Storage and Conversion Energy
Magnetic nanomaterials
Spin Physics and Technology for Spintronics
High-Tc superconductor
Environmental magnetism

Main research directions



Some typical projects (1)

- Nano bandages for burn wounds treatment (VAST)
- Nano particles for increasing the contrast of magnetic resonance imaging techniques (MRI) (VAST)
- Nano paint with air pollution treatment function (TiO_2/Apatite, TiO_2/Al_2O_3 and TiO_2/ quartz cotton) (VAST)
- Application of metallic nano particles (Fe, Cu) in livestock (VAST)
- Synthesis of biomedical materials: the powder of calcium hydroxyapatite (HA) in nano size used as a calcium dietary supplement and osteoporosis drugs, the foam blocks of HA used in orthopedic surgery, (VAST)
- Nano Curcumin (VAST)
- Synthesis of Nano-Ag using extracts from plants and microwave (Science University, Hue University)

Some typical projects (2)

- Nano optoelectronic materials (VAST)
- Polymer Nano – dendrimers materials: Synthesis and applications in medicine and pharmacy (VAST)
- Saving energy with new lighting technology, applying in residential, industrial, transportation, agriculture (VAST)
- Nano-Carbon tube technology(CNTs), nano clay, Graphene material (foundation for other applications); (VAST)
- Technology of composite materials with polymer foundation, rubber foundation, cement foundation, metal foundation, using nano materials to strengthen and create remarkable features, applying in the irrigation industry, construction, security and defense…;
- Cooperation with other units in and out of Institute of Academy, in partnership with enterprises to research and develop, apply and commercialize the products of advanced materials.

NanoTech related Workshops

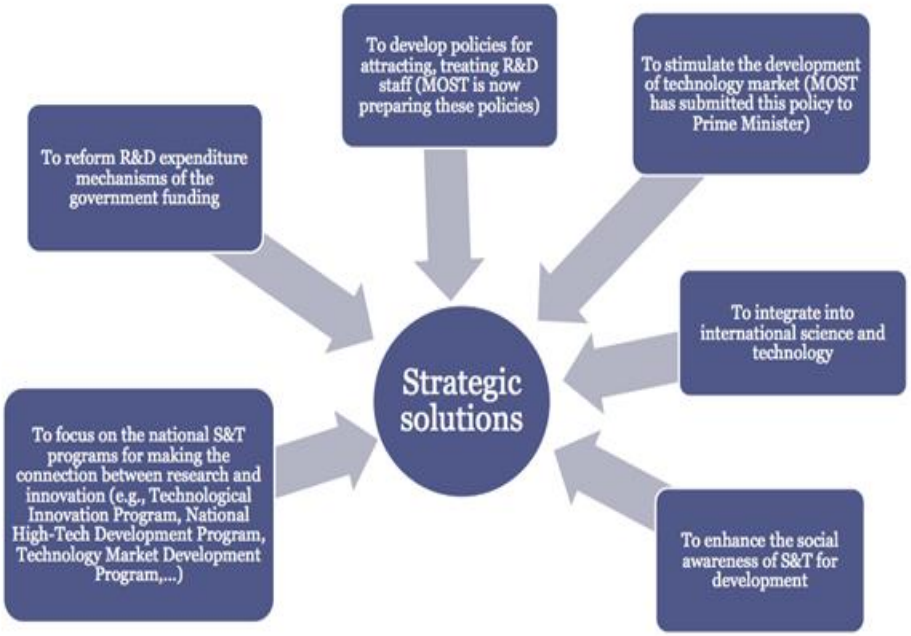
- **International Workshop on Advanced Materials Science and Nanotechnology (IWAMSN)**
- **International Workshop on Nanotechnology and Application (IWNA)**
- **International Workshop on Advanced Materials and Nanotechnology (IWAMN)**
- **International Workshop on Nano Materials for Energy Conversion (NMEC)**
- **Analytica Vietnam**

Current status of research

Key institutions involved in nanotechnology policy and research:

- Ministry of Science and Technology (MOST)
- Vietnamese Academy of Science and Technology (VAST)

STI Policy



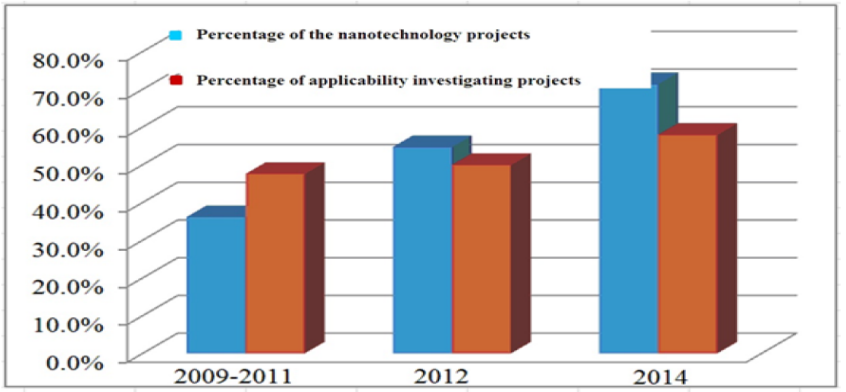
Innovation Reform

1986 1987 1996 now

Non-public R&D

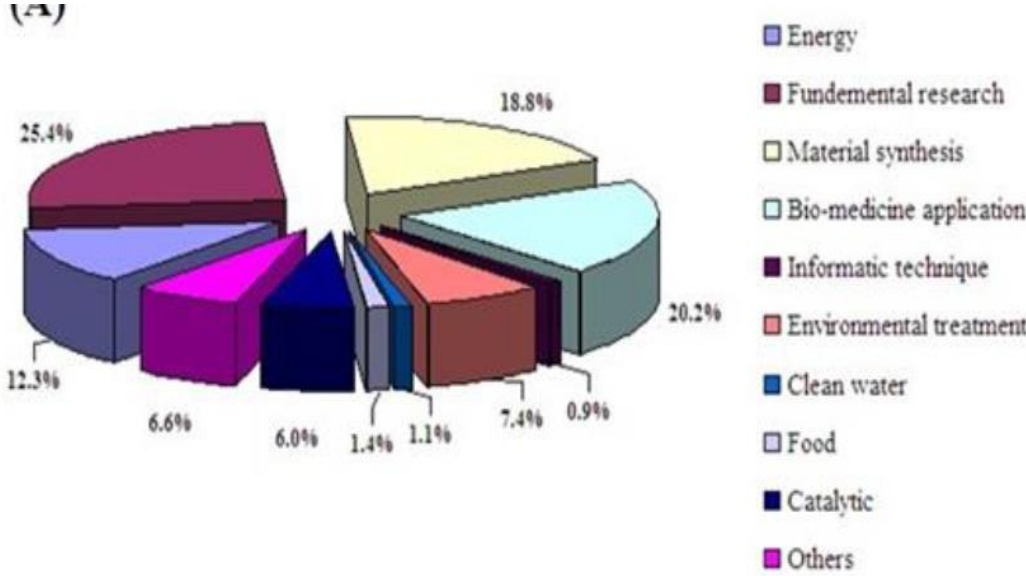
Concerning specific targets, Vietnam is now heading to:

- High-tech products ~ 45 % GDP
- ↑ Transaction value of the S&T market > 15% / year
- ↑ Patents ~ 3 times
- STI officers 11-12 /10,000 people (qualified)
- 60 basic research organizations by 2020
- 5000 S&T enterprises
- 30 high-tech enterprises and incubators



Proportions of the project numbers that nanotechnology (blue) and applicability research (red)

Statistics- Publications (1)



VIETNAM Nanoscience & Nanotechnology profile

Time (2016/01/01 to 2016/12/31)	Quantity	Rank
ISI indexed nano-articles	457 articles	42th
Five year average citation per nano-article	4.28	84th
Five year h-Index of nano-articles	29	47th
National priority in nanoscience	1.35	18th
International Conferences, Workshops and Seminars in Nanotechnology	4	
Number of nano-articles per GDP(ppp)	0.66 /billion $	58th
Number of nano-articles per Million people	3.98	74th
Share of international collaboration in nanoscience	63.74 %	72th

Population (2015) :91,703,800 (People)
GDP (2015) :193,599.4 (Million $)

Source StatNano

Statistics- Publications (2)

Table 3: Top 20 Countries in Share of Nanotechnology Articles out of All Scientific Articles in 2014 (for the countries that published over 50 nano-articles in 2014)

Rank	Country	Share of Nanotechnology Articles from All Articles (%)
1	Moldova	25.78
2	Iran	21.15
3	Singapore	19.49
4	Bahrain	18.34
5	Iraq	17.67
6	India	17.31
7	China	16.84
8	Ukraine	16.33
9	Saudi Arabia	16.13
10	South Korea	15.7
11	Belarus	14.7
12	Malaysia	14.28
13	Taiwan	12.89
14	Egypt	12.84
15	Romania	11.87
16	Russia	11.82
17	Latvia	10.82
18	Vietnam	10.74
19	Thailand	9.91
20	Bulgaria	8.65

An observation to the ratio of nanotechnology articles to all scientific articles (Local Share) published by various countries shows that similar to the previous years, the Asian countries pay more attention to nanotechnology.

There are 8 Asian countries among the top 10 countries in this indicator. Moldova, Iran and Singapore possess the first to the third ranks in this ranking.

Source StatNano

Funding Agencies

Vietnam Academy of Science and Technology

Ministry of Science and Technology

National Foundation for Science and Technology

National Technology Innovation Fund

Commercialization

Energy

- **Nanocarbon** materials (CNTs, graphene)
- Nano **ZnS**, **ZnO**, **TiO_2**, nano **Si**…
- Nano **phosphor** for LED
- Nano **MoS_2**, **perovskite** for water splitting

Sensors

- **Conducting polymer** nanostructures (PANi, PPy, PEDOT, PDAN…)
- **Quantum dots** (CdSe, ZnSe, CdS…)
- Semiconductor **metal oxides** (WO_3, ZnO, SnO_2…)

Biomedical

- Nano**chitosan**-based slow-release drug vehicles
- Nano**cucumin**
- Nano **silver** and **gold**
- **Magnetic** nano-particle
- Nano **HAp**

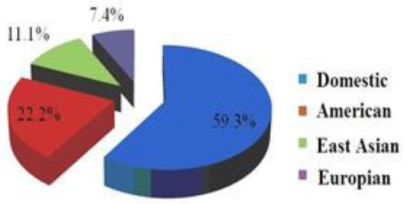


Figure 2.4. Classification of nanotechnology products based on origin.

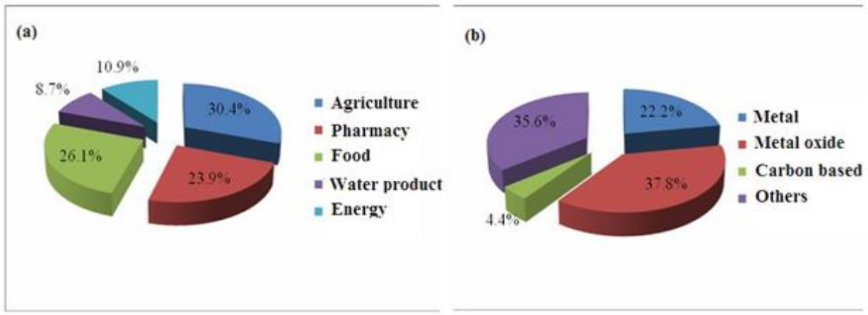


Figure 2.3. Distribution of nanotechnology products on Vietnamese market due to (a) field-like classification and (b) material classification

3. Application potency and developing capability

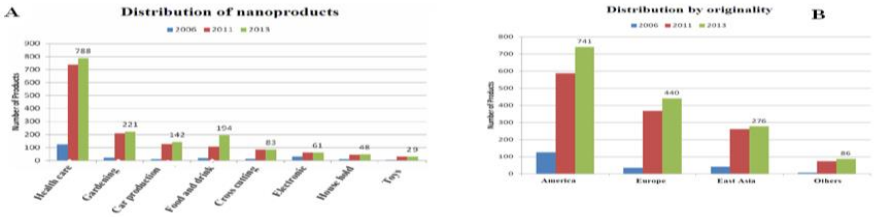


Figure 2.5. Distribution of nanotechnology product based on (a) trading profession and on (b) origin

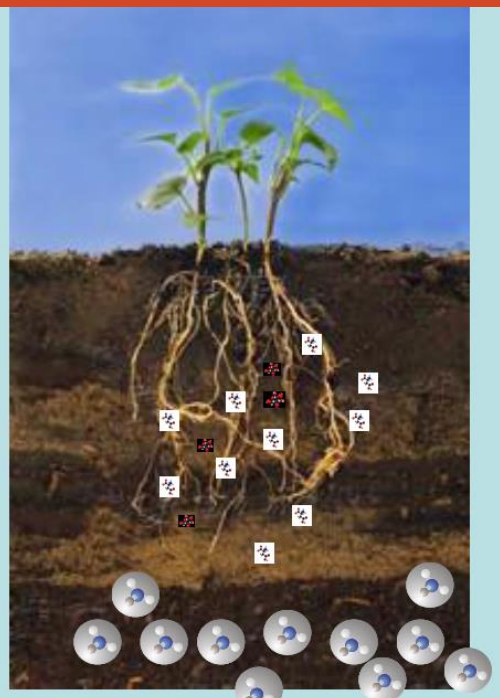
Environment

- **TiO2**
- Nano**silica** from rice hurk
- Zeolite, MOF, ZIF

Smart materials

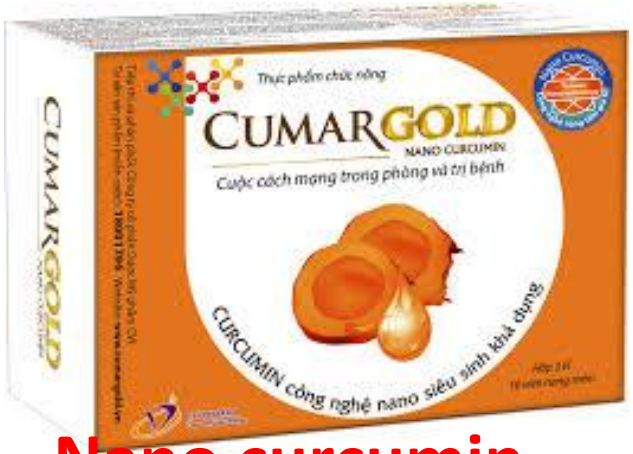
- **Polymer** nanostructures (conducting and thermal sensitivity).
- **Magnetorestrictive** materials
- **Rheological** Materials
- **Chromogenic** (electrical, optical or thermal changes)

Typical Nanoproducts (1)



Nano fertilizer

Mixed LED

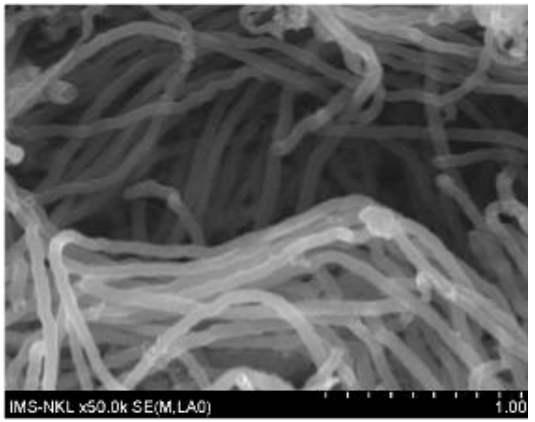


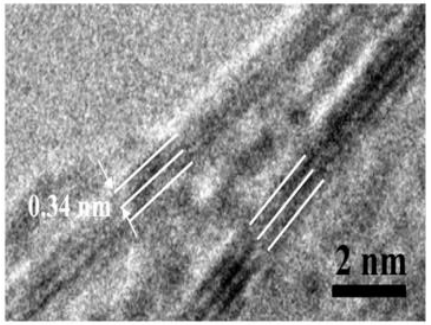
Nano curcumin

Nano silver

Nano paint

Typical Nanoproducts (2)





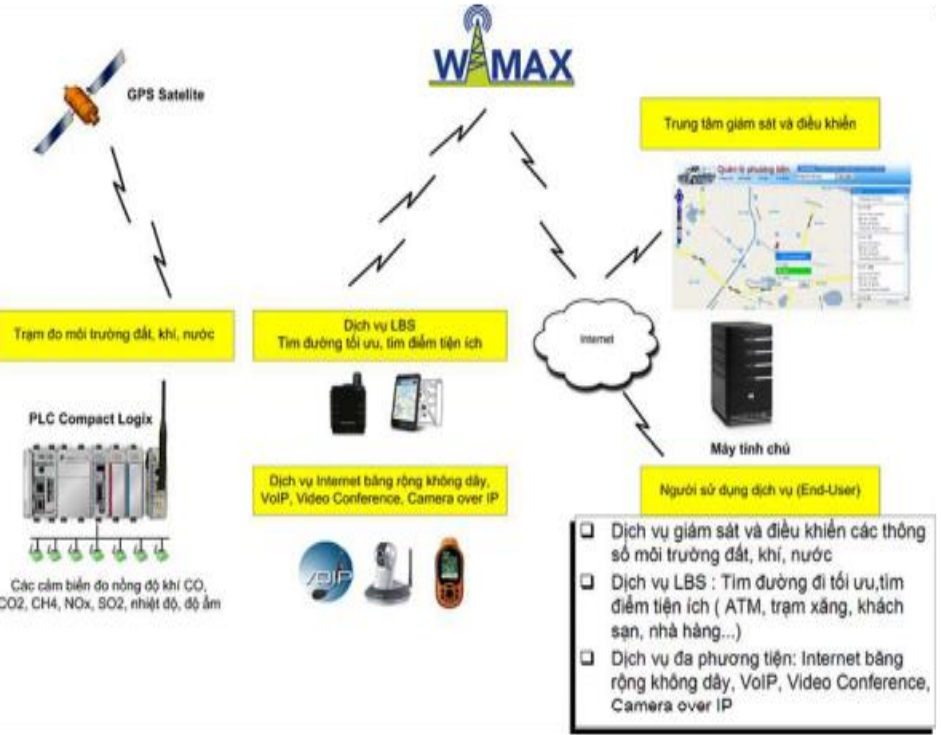
CNT and Graphenes

Typical Nanoproducts (3)

Infrastructure: Information technology, telecommunication, GPS, Wireless sensor network (WSN), RFID, WIMAX…

Monitoring and decision making capabilities

Precision Farming → **Quality control:** farmers, distributors, consumers

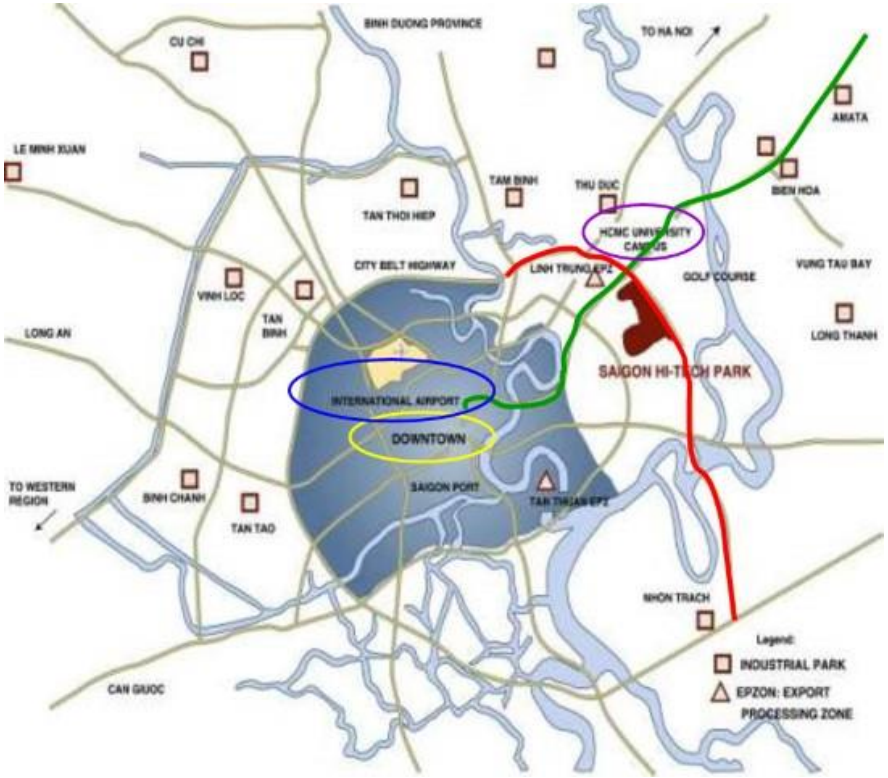


- Coffee
- Tea
- Orchids
- Rice
- Aquaculture

Hanoi and Saigon High- tech parks

HHTP

SHTP
SAIGON HI-TECH PARK



SHTPLABS
SAIGON HI-TECH PARK R&D CENTER

Start up and spin off (1)

NANOGEN BIOPHARMACEUTICAL , since 2001
Biopharmaceutical products from gene to therapy, serving high quality and innovative drug products for treatment of hepatitis B, hepatitis C, anemia due to chronic renal failure, myocardial infarction and cancer…

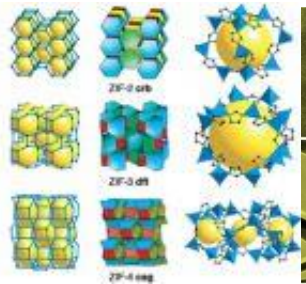
Vietnam Nano Technology Company Limited (VINANOTECH), since 2010
Carbon-based nano materials

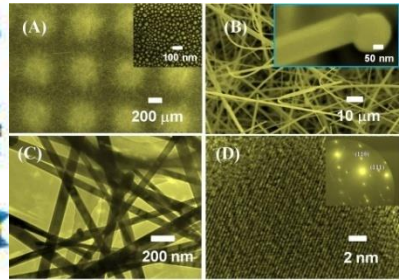
New Light LED Technology Ltd., Co. (ASAMLED)
Led chip nano technology

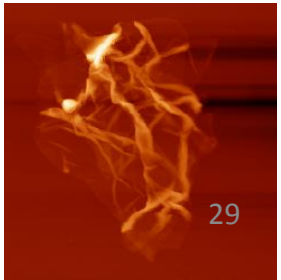
EnviBioChem Bình Lan
Nano silver with high conversion ratio

NA NÔ TECHNOLOGY CO., LTD
Nano fertilizers

APA United Nano Technology Co.,LTD
Veterinary medicine







Start up and spin off (2)

Nanogen Biopharmaceutical is a leading company that is doing research and development into active Biopharmaceutical ingredients (APIs) and specific therapeutic injections in the Asia Pacific region. Their work focuses on advances in recombinant DNA and protein technologies.

NANOGEN
BIOPHARMACEUTICAL
ADVANCING BIOTHERAPEUTICS

Nanogen Biopharmaceutical Co.
Address: Saigon Hitech Park, HoChiMinh City, VIETNAM
http://www.nanogenpharma.com

At the end of 2006, Intel announced that it was going to invest USD 1 billion to construct its seventh and largest assembly test facility in Intel's global network to produce chipsets.

Start up and spin off (3)

DANAPHA PHARMACEUTICAL JSC

Danapha was established in 1965 as Vietnam Central Region Pharmaceutical Factory with the primary mission of providing pharmaceuticals in fields ranging from disease prevention to treatment for Vietnamese people and soldiers.

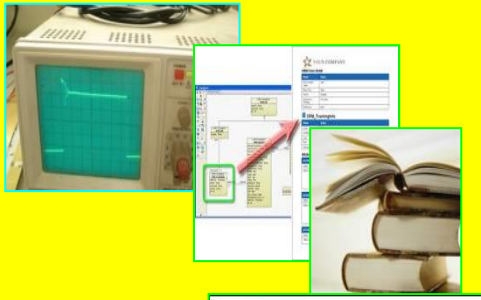
Nanotechnology-applied products: Gasmin, Moflex, Silysom, Nanogold, Liposome …

Address: Da Nang City, VIETNAM

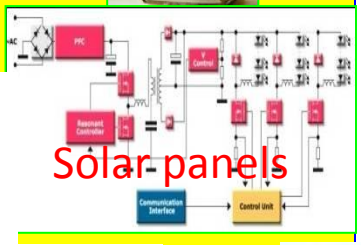
http://www.danapha.com

Start up and spin off (3)

VAST



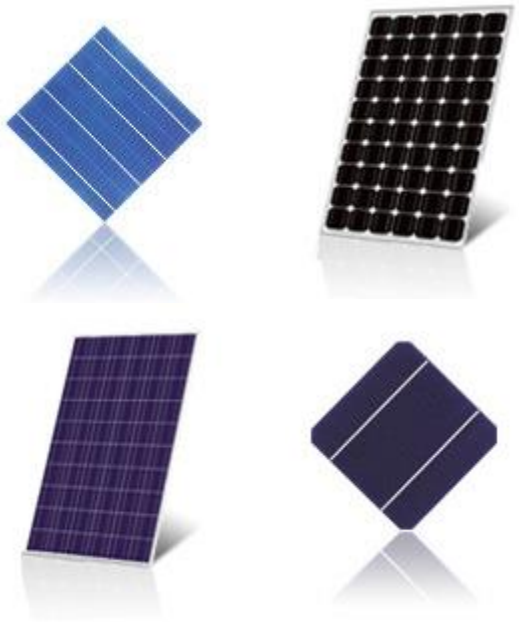
BOVIET



Solar panels

LED

RALACO



Nanosafety management (1)

Key institutions involved in NanoTech policy & research: Ministry of Science and Tecnnoiogy (MOST) and Vietnam Academy of Science and Technology (VAST)

Indirect regulations relating to the production and use of nanomaterials:

- Law on Environmental Protection 2014;
- Law on Chemicals 2007;
- Law on High Technology 2008 (item c of Article 5 regulated new material technology is high technology for investment and development priorities);
- Decree No. 80/2010/ND-CP dated 14 July 2010 of the Government regulated on cooperation with foreign investors in the field of science and technology;
- Decision No. 127/QD-TTg dated 20 January 2011 of the Prime Minister approved the detailed planning on developing radiation application in industry and other technical and economic sectors (including metal nanomaterials, nano composites used in industry, agriculture, health care, and cosmetics) by 2020;
- Decision No. 2457/QD-TTg dated 31 December 2010 of the Prime Minister approved the national program for development of high technology by 2020;
- Circular No. 02/2001/TT-BKHCNMT dated 15 February 2001 of the Ministry of Science, Technology and Environment guiding the standards of industrial projects which to be encouraged for investment on the production of new materials, rare materials; application of new bio-technology; application of new technology for the production of communications equipment, telecommunications, environmental pollution treatment or treatment and processing of waste...
- Regulation No. 02/2001/TT-BKHCNMT

No standards & technical regulations on safe thresholds for nanomaterials, as well as the direct regulations related to the nanosafety.

Nanosafety management (2)

Few programs on nanosafety

VIETNAM - NANO SAFETY MANAGEMENT PROGRAM FROM 2016 TO 2020 AND VISION TO 2025

Objective: protection of environment and human health

Tasks:

- Promote activities in research & management of impacts related to NanoTech & NanoMat.
- Increase awareness of authorities, relevant stakeholders and community on nanosafety.
- Formulate specific regulations for nanosafety management.

-Create conditions for development of NanoTech & NanoMat which contribute to sustainable development of Vietnam.

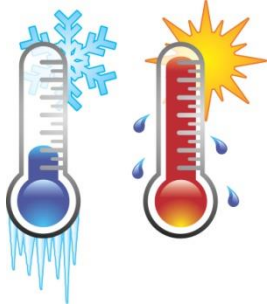
WORSHOP FOR RAISING AWARENESS ON NANOSAFETY

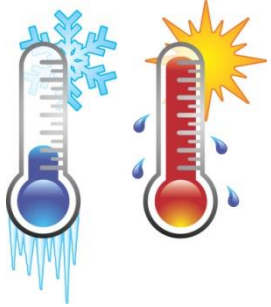
Hanoi, 28 March 2014

unitar
United Nations Institute for Training and Research

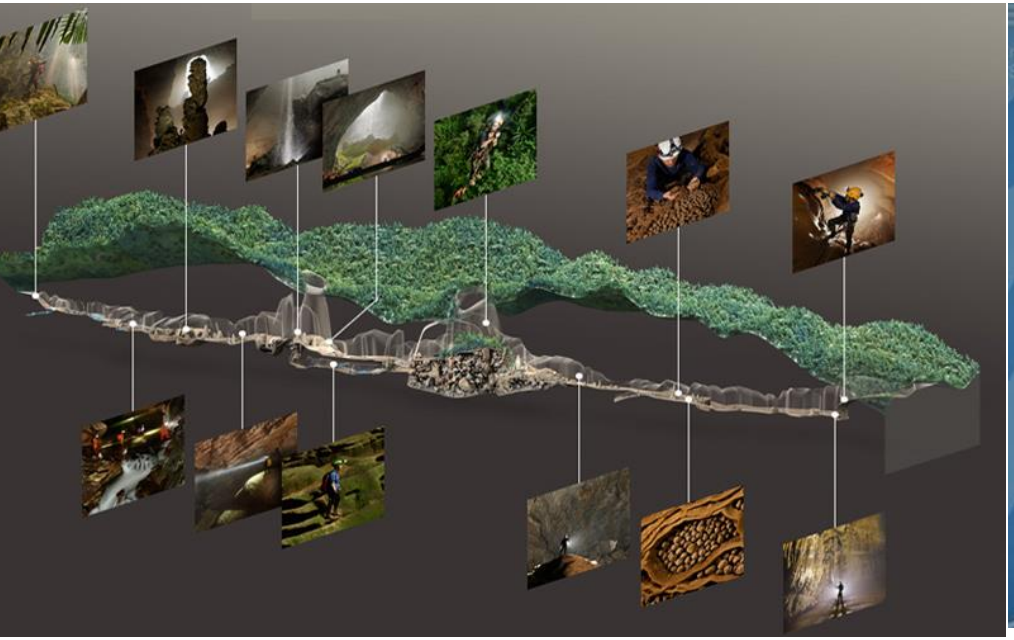
WORKSHOP AND TRAINING COURSE ON NANO SAFETY IN VIETNAM

Hanoi, 5 - 6 May 2016





- Son Doong cave: the largest known cave passage cross-section in the world (2009)
- Vietnam runs for UNESCO Director-General position
- Donald Trump praises North Korean leader as a 'smart cookie'
- etc…



….But not nanosafety at all

Concluding Remark

Research	Industry	Policy
-Available research base -Regional level	Promising potential but not real breakthroughs in core values	No regulations & standards

MUST HAVE

Management system
Interdisciplinary cooperation
Education – Research – Industry

“

We are not much slower than the world in fundamental research but lagging far behind the rest of ASEAN in policy and standards, which makes it difficult to transfer and get into practice’’

Prof. NGUYEN VAN HIEU, VAST

“There are too many projects working on the effectiveness of nanomaterials but they really forget that the more the materials are effective the more they are harmful. We need to work with a safety-first culture to become healthier’’

Dr. TRUONG QUOC CUONG, MoH