Advanced Materials: From Research to Application – Opportunities and Collaboration Needs

Advanced Materials | Research | Applications

Session 4: Accelerating the Transfer and Application of Strategic Technologies: Biotechnology, Medicine and Pharmaceuticals, and Clean Energy

Dr. Dao Nguyen Thuan • 05.11.2026

HISTORY

VAST

1975 — **1994** — **2004** — **01/4/2026**

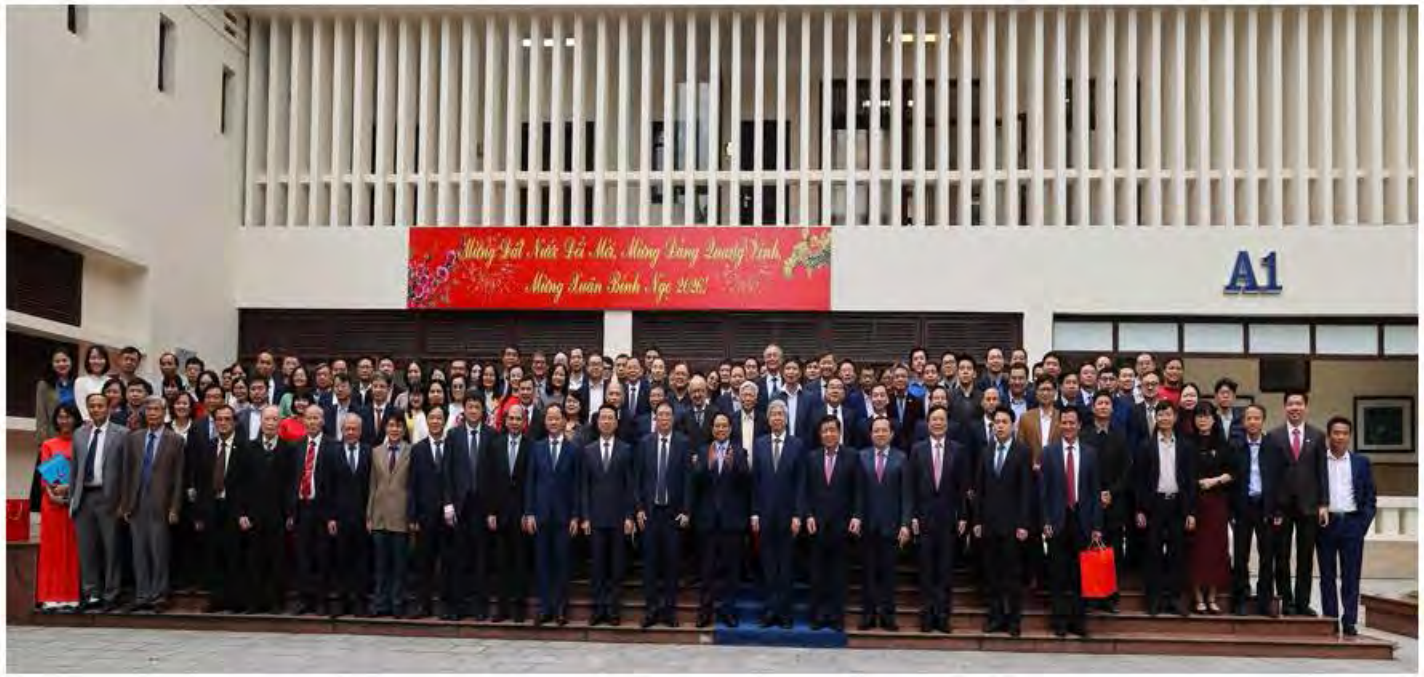
Established as:
Vietnam National Center for Scientific Research

Vietnam National Center for Natural Science and Technology

Vietnam Academy of Science and Technology

Vietnam Academy of Science and Technology
Under Central Committee Party - Restructured





MISSIONS

VAST: Vietnam's Leading Multidisciplinary Research Institution



FUNDAMENTAL RESEARCH

Implementing fundamental research in natural sciences.



TECH & INNOVATION

Developing technology and facilitating innovation.



S&T EDUCATION

Education and training in S&T.



POLICY INSIGHTS

Providing insights for the Central Committee Party on S&T policies.

STRUCTURE

VAST

President

Scientific Council

Vice Presidents

Administrative Units

- Department of Organization, Personnel and Inspection
- Department of Planning and Finance
- Department of Science and Technology
- Department of Education and international Cooperation
- Administrative Office
- Foundation for Science and Technology Development

Research Units

- Institute of Mathematics
- Institute of Physics
- Institute of Chemistry
- Institute of Mechanics
- Institute of Earth Sciences
- Institute of Biology
- Institute of Oceanography
- Institute of Energy and Environmental Science and Technology
- Institute of Materials Science
- Institute of Information Technology
- Institute of Life Sciences
- Institute of Advanced Technology
- Vietnam Space Center

Other Units

- High-Tech Innovation Center
- Data and Scientific Information Center
- Vietnam National Museum of Nature
- Publishing House of Natural Science and Technology
- Graduate University of Science and Technology
- University of Science and Technology of Hanoi (USTH)

VAST Human Resources

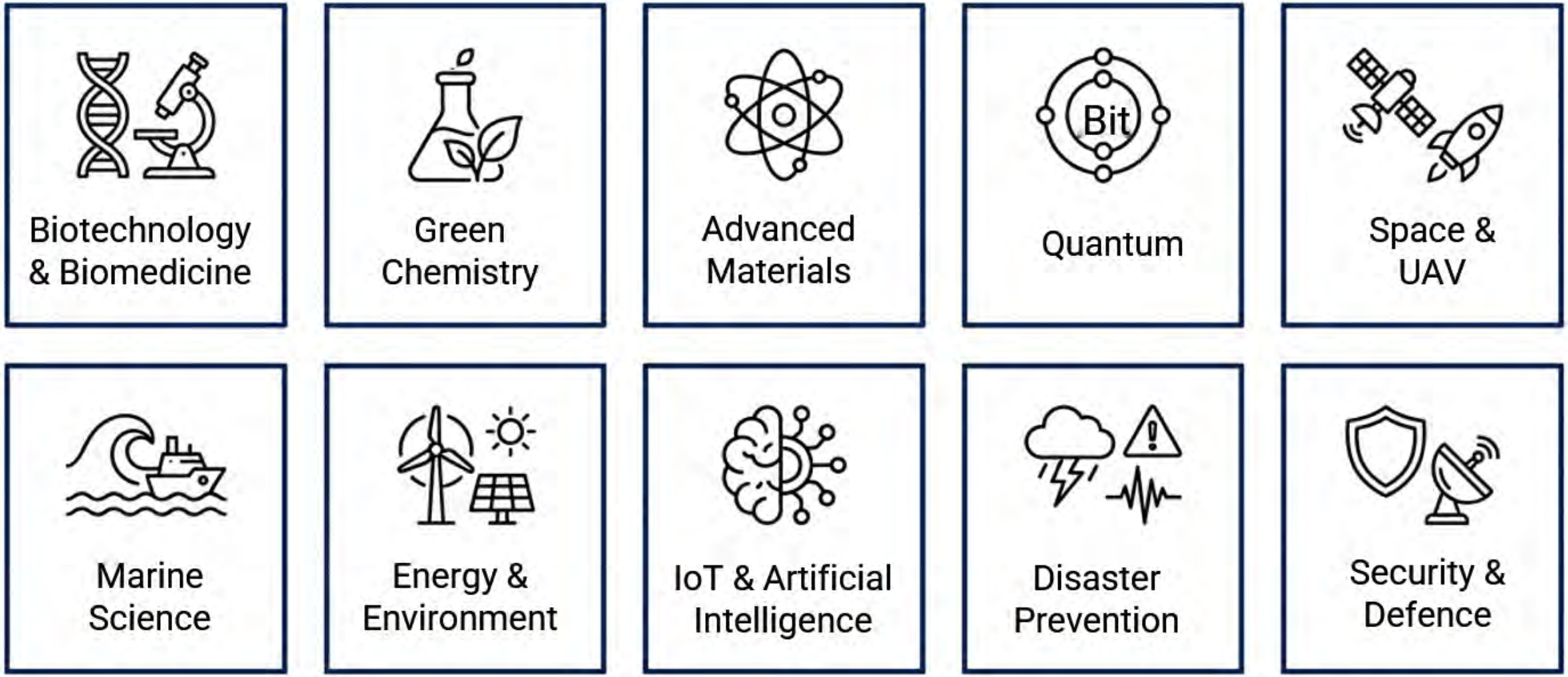
~3,000 Staff Members

1,000 PhDs and **1,000** Masters

60 Professors and **200** Associate Professors

Overview of VAST's 10 Priority Technology Areas

Focused resource allocation for 2026–2030 to achieve autonomy in foundational technologies.



INSTITUTE OF MATERIALS SCIENCE

Founded June 1993

Starting from March 2025, in accordance with Decision No. 350/QD-VHL by the President of the Vietnam Academy of Science and Technology,

the Institute for Tropical Technology merged with the Institute of Materials Science







4 Research Buildings + 1 Technology Development Zone + 7 Testing Stations

STRUCTURE

Division
5

National Key Lab
1

Laboratory
21

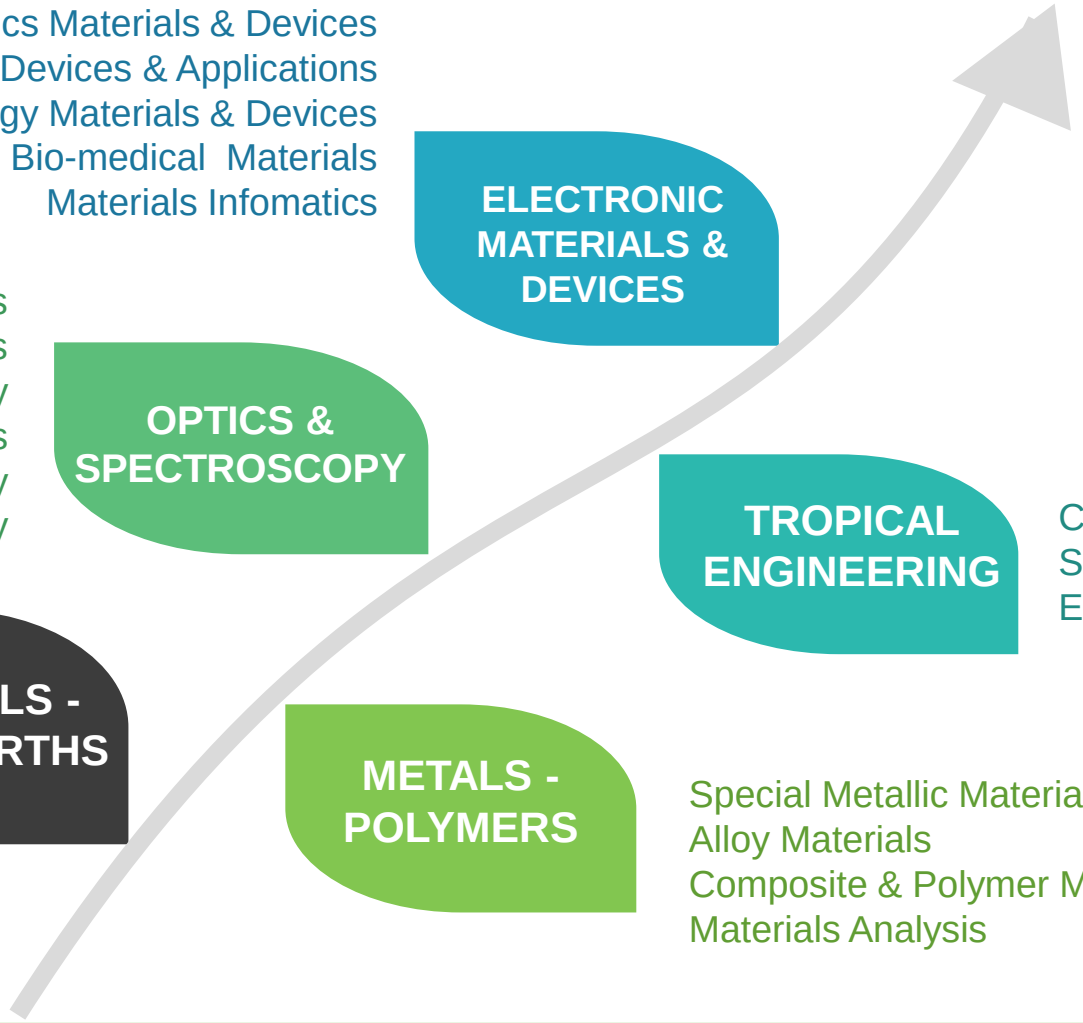
R&D Center
5

Staffs
250+

- 6 Professors
- 17 Associate Professors
- 101 PhDs

PhD Students
50+

RESEARCH STRUCTURE



ELECTRONIC MATERIALS & DEVICES

Electronic, Magnetics Materials & Devices
Sensor Devices & Applications
Renewable Energy Materials & Devices
Bio-medical Materials
Materials Infomatics

OPTICS & SPECTROSCOPY

Optoelectronic, Photonic Materials
Photo-catalyst Materials
Lighting Technology
Optoelectronic Devices Applications
Applied Spectroscopy
Plasma Technology

TROPICAL ENGINEERING

Corrosion and Material Protection
Surface Treatment and Protection
Electrical Engineering

MINERALS - RARE EARTHS

Rare-Earth, Mineral Processing
Environmental Technologies
Advanced Materials for Agriculture
Materials for Waste Treatment
Catalyst Materials & Devices

METALS - POLYMERS

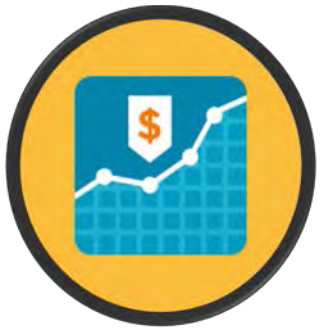
Special Metallic Materials
Alloy Materials
Composite & Polymer Materials
Materials Analysis

INSTITUTE OF MATERIALS SCIENCE

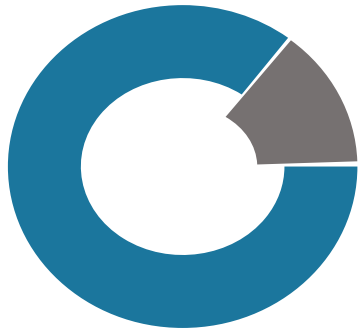
Project

240

- State level: 16
- NAFOSTED Foundation for Basic Research: 35
- Cooperation: 10
- Ministerial level - VAST level: 100
- Grassroots level: 80



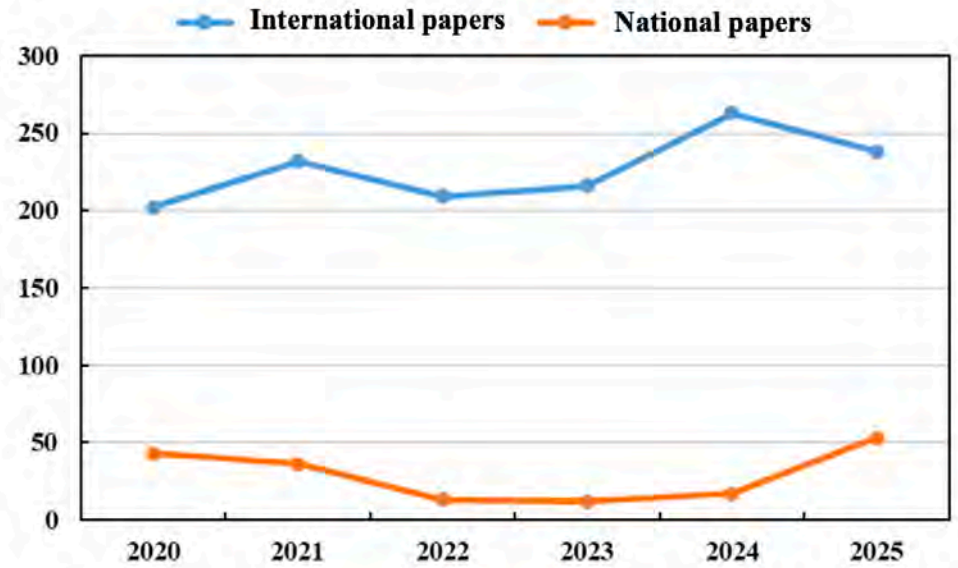
- Science and technology contracts: ~ 1.7M USD
- Recurrent expenditures: ~ 1.7M USD
- Research funding: ~ 3.0M USD
- Equipment Investment (22-25): ~ 3.8M USD



- Patent: **23**
- SCIE Publication: **~ 250**

Influence Index ~4.2

The results of the study are equivalent to those of the Korea Institute of Materials Science(KIMS)

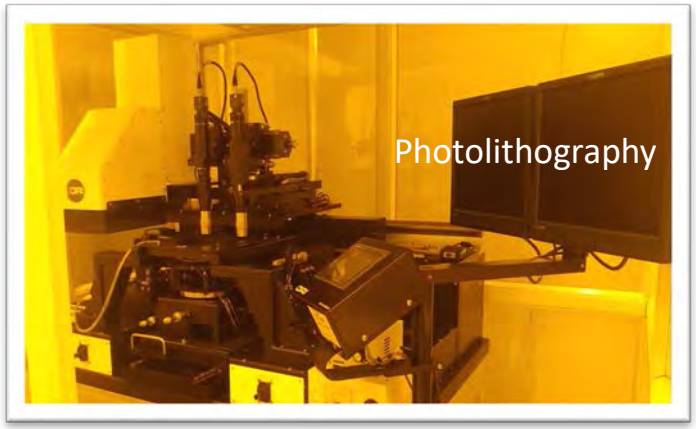


Number of scientific papers in the last 5 years

RESEARCH FACILITIES

- MICROWAVE SYNTHESIZER
- CLEAN ROOM, CLASS 10,000
- SPUTTERING (UNIVEX 400, LEYBOLD)
- PHOTOLITHOGRAPHY (M-8000, OAI)
- LASER ABLATION DEPOSITION (MECA 2000)
- NANO POWER FABRICATION SYSTEM
- MELT SPINNING SYSTEM
- THERMAL/CHEMICAL VAPOR DEPOSITION
- HOT ISOSTATIC PRESSER & SPARK PLASMA SINTERING
- THERMAL/COLD PLASMA SYSTEM
- ...


Sputtering


Photolithography


High-Vacuum Induction Melting-Casting System


Cleaning room


Microwave Synthesizer


Spark Plasma Sintering


Thẻrmal DC Plasma

MATERIAL FABRICATION (>80 Equipment System)

RESEARCH FACILITIES

















- HR-TEM (JEM 2100 JEOL)
- FE-SEM (S-4800, HITACHI)
- X-RAY DIFFRACTOMETER (EQUINOX 5000)
- RAMAN SPECTROMETER (XPLORA +, HORIBA)
- HR PHOTOLUMINESCENCE (iHR 500, JOBIN YVON)
- PHYSICAL PROPERTIES MEASUREMENT SYSTEM (PPMS 6000)
- LIGHT SOURCE CHARACTERIZATION SYSTEM (EVERFINE)
- METAL & POLYMER CHARACTERIZATION SYSTEM
- METARIALS FAILURE ANALYSIS SYSTEM
- GAS CHROMATOGRAPHY, ION CHROMATOGRAPHY

. . .

MATERIAL ANALYSIS (>100 Equipment System)

Institute of Materials Science

Address: 18 Hoang Quoc Viet, Hanoi, Vietnam Webste: www.ims.ac.vn

RESEARCH HIGHLIGHTS

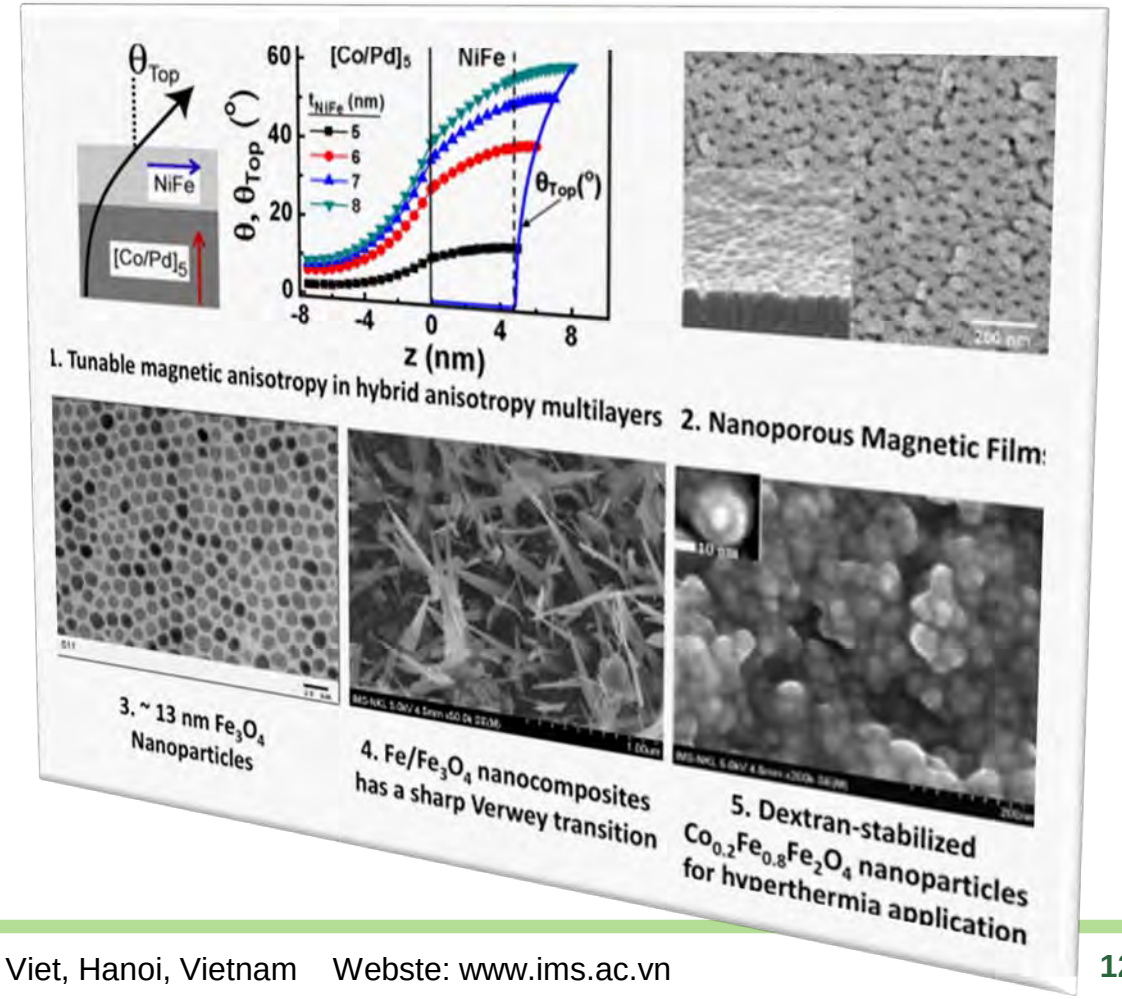
MAGNETIC MATERIALS AND DEVICES

FUNDAMENTAL PROPERTIES OF MAGNETIC MATERIALS

+ magnetic transition, magnetic states, magnetic anisotropy, magnetic moment …
+ thin film, multi-layer structure, nanoparticles, core-shell nanoparticles, nanocomposite …
+ different composition: Fe, Co, Ni, Mn …
+ different sizes and shapes

TAILORING MAGNETIC MATERIALS FOR APPLICATIONS

+ bio-compatible core-shell magnetic nanoparticles for hyperthermia applications
+ magnetic nanoparticles for water purification
+ magnetic materials for permanent magnet



RESEARCH HIGHLIGHTS

LUMINESCENT MATERIALS AND APPLICATIONS

FUNDAMENTAL PROPERTIES OF LUMINESCENT MATERIALS

+ controlling the bandgap of quantum sized systems, temperature dependence, time-resolved measurement, dynamics of photoluminescence …
+ semiconductor quantum dots, graphene quantum dots, rare-earth doped nanostructured materials …
+ different composition: CdTe, CdS, ZnS …
+ different sizes and shapes
+ doping with different elements

LUMINESCENT MATERIALS FOR APPLICATIONS

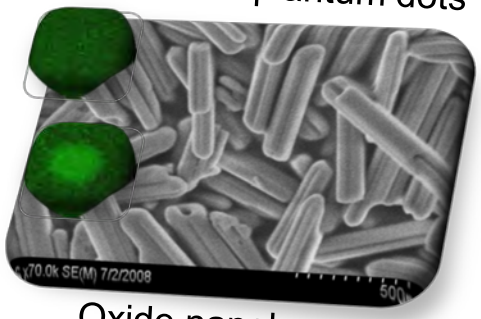
+ producing high-quality of photoluminescent materials
+ visible light driven photocatalytic materials for environmental treatment
+ photo-electrodes for water-splitting in producing clean hydrogen fuels
+ biomakers



Graphene quantum dots



Semiconductor quantum dots



Oxide nanobars

RESEARCH HIGHLIGHTS

LOW-DIMENSIONAL MATERIALS AND APPLICATIONS

Carbon nanotubes

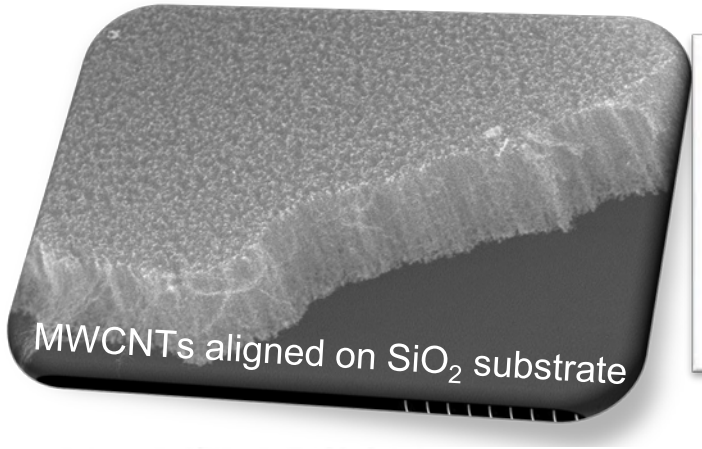
+ fabrication of high-quality MW/SW CNTs (small-diameter, long, high purified)
+ radar absorption, solar heat absorption, nanofluid for computer/LED cooling

MoS_2 / Graphene

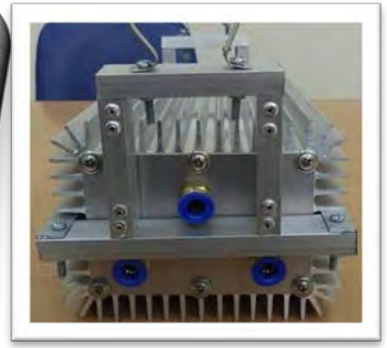
+ fabrication of high-quality graphene film, transferred film, powders …
+ preparing solar panels made of hybrid material Si (nanowires)/PEDOT: PSS/Graphene.

Nanoclusters

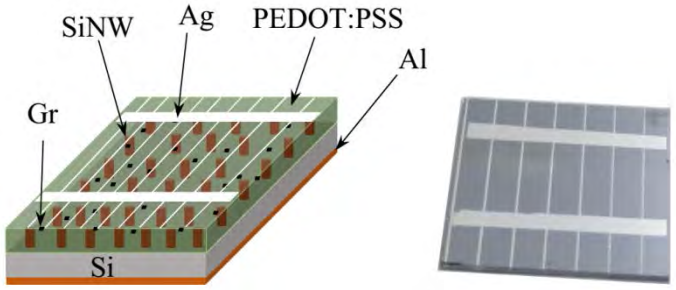
+ tailoring electronic and geometric structure
+ chemical adsorption, reaction process, photon absorption and dissociation



LED with dispersed-CNTs cooling nanofluid module







Model and structure of SiNW/PEDOT:PSS/Graphene solar panel after fabrication



Photon induced dissociation in cobalt oxide clusters

RESEARCH HIGHLIGHTS

BIOMEDICAL NANOMATERIALS

NANO BIO-COMPLEXES **F**UCOIDAN – **G**INSENG – **C**URCUMIN

+ Increasing the solubility of Curcumin 2000 times,
+ Reduce side effects
+ Improve health & supporting cancer treatment
+ Technology transfer to industry (0.2M USD annually)



Patent No. 22424 granted by the National Office of Intellectual Property (2019)





RESEARCH HIGHLIGHTS

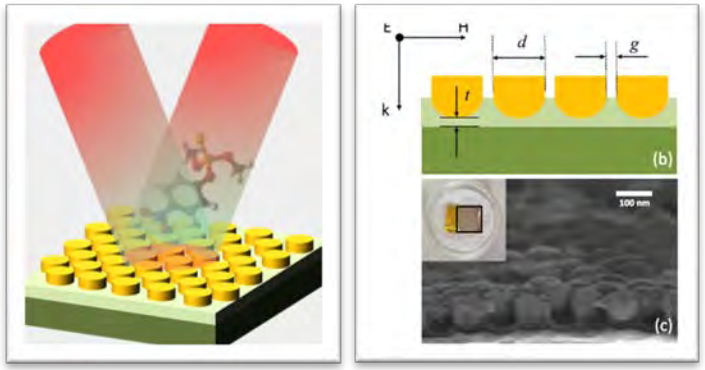
PHOTONIC MATERIALS AND APPLICATIONS

DESIGN & FABRICATION

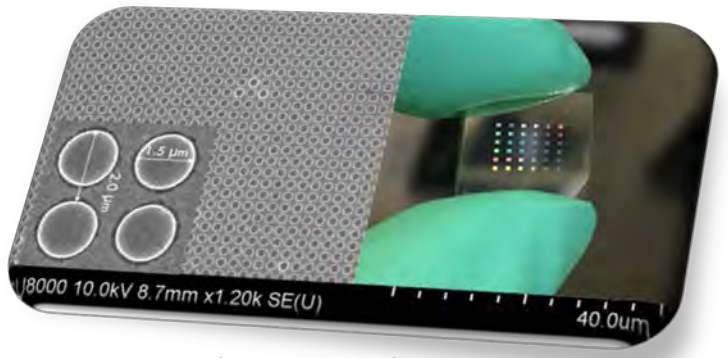
+ operating at different ranges from MHz, GHz, THz, IR and visible frequencies)
+ narrow band, broadband, multiband
+ negative refraction, high absorption, metasurfaces
+ tunable frequency, multi functionality



Photonic materials at different size scales



SERS substrate for ultrasensitive molecular probing



Photonic device
for THz energy harvesting

APPLICATIONS

+ ultrasensitive detection of molecules
+ surface enhanced raman scattering (SERS)
+ surface enhanced IR absorption (SEIRA)
+ energy harvesting (GHz)

RESEARCH HIGHLIGHTS

OPTOELECTRONIC APPLICATIONS AND DEVICES

MEDICAL APPLICATIONS AND DEVICES

+ materials for biomakers
+ materials for enhancing MRI image resolution
+ IR vein viewer
+ laser therapy equipment



Infrared vein viewer



Multi-channels laser therapy equipment



LED lighting for "night break" Chrysanthemum flower



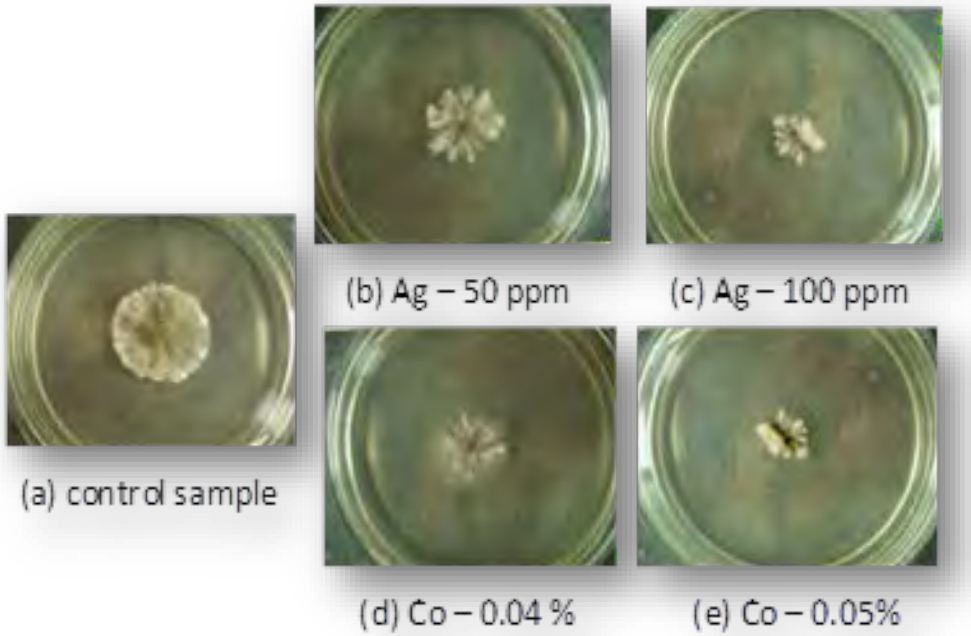
Hybrid Solar/LED lighting for plant growing

LIGHTING ENGINNERING

+ human centric lighting, high-efficiency lighting
+ lighting for agriculture
+ energy saving solution, artificial sun lighting
+ eye vision correction using lighting

RESEARCH HIGHLIGHTS

NANOMATERIALS IN AGRICULTURE



NANO ANTIBIOTICS

+ Increased activity.
+ Reduce the dose of antibiotics.





NANO METAL Ag, Co

+ Inhibition of plant fungal growth.

NANO FOLIAR FERTILIZER

+ Trace organic fertilizers contain Cu, Zn, Mo.

RESEARCH HIGHLIGHTS

SENSING APPLICATIONS AND DEVICES



NDIR gas sensors
(CO, CO_2, HC, NO_x)



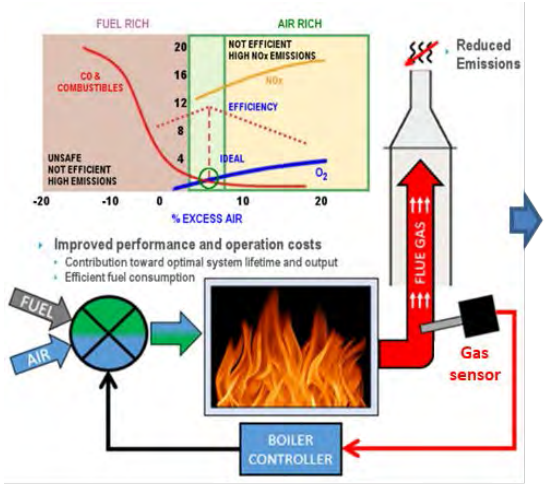
High-temperature O_2 gas sensor

+ non-dispersive infrared (NDIR) gas sensors
+ high-temperature electrochemical gas sensors
+ photonics-based IR sensors

Sensing Devices

Industry Applications

+ smart sensing systems for reducing pollutant emission, saving energy in cement industry
+ IoT sensing systems for ultrahigh sensitivity, fast analysis, automatic response in agriculture applications





Target analysis gases
(O_2; CO; NO_x; HC ; CO_2)

Smart sensing system for cement industry

RESEARCH HIGHLIGHTS

METALS, ALLOYS AND SPECIAL METALLIC MATERIALS

SPECIAL METALS AND ALLOYS

+ hard alloys based on tungsten carbide using hot isostatic pressing (HIP) technology
+ CNTs reinforced metallic nanocomposite by HIP and plastic deformation
+ functional high entropy alloys
+ special alloys for wears and corrosion applications

APPLICATIONS

+ copper heat pipes for high performance LED and other heat sink applications
+ protective coating layer for cutting tools



Copper heat pipe for high power LED: λ > 10.000 W/m.K



Coating for cutting tools

RESEARCH HIGHLIGHTS

POLYMER - COMPOSITES



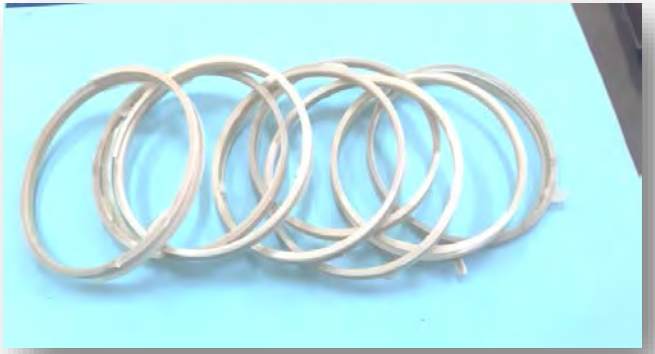






- KINETIC ENERGY PENETRATION CORE MATERIAL

  + Ultra-high temperature resistant.



- 82M SHELL GASKET JOINT

  + reducing



RESEARCH HIGHLIGHTS



TECHNICAL SERVICE FOR INDUSTRY

Customers

+ Power plants
+ Refineries
+ Chemical plants
+ Fertilizer Plants
+ Sugar/Paper mills
+ Mechanical enterprises
+ Supporting industry



In-house training, materials testing & condition assessment of components

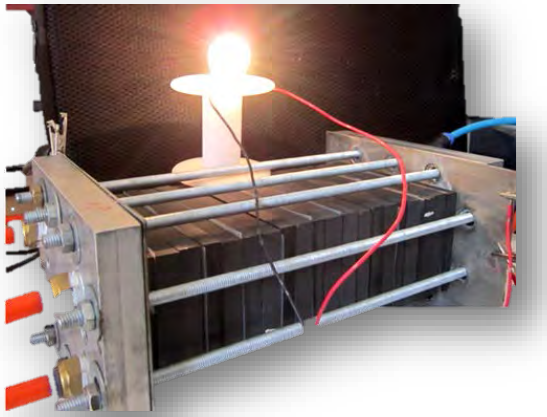
+ saving input materials
+ faiulure prevention
+ quality improvement
+ better maintance
+ higher efficiencey and sustainability

RESEARCH HIGHLIGHTS

MATERIALS AND DEVELOPMENT OF FUEL CELL

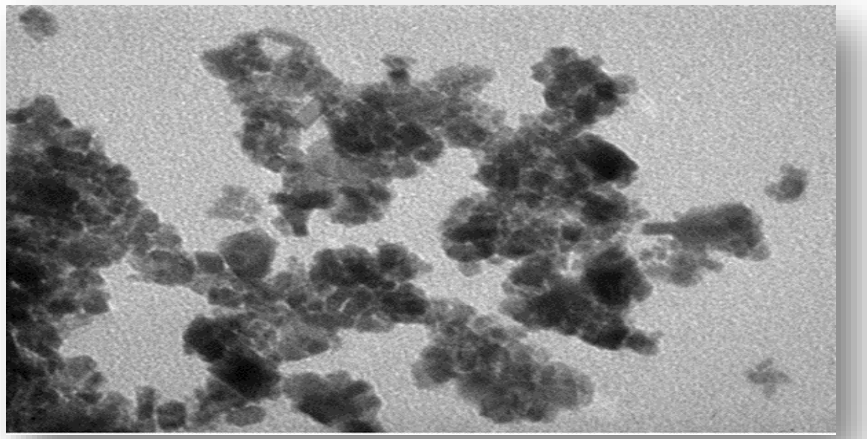
DEVELOPMENT OF FUEL CELL

+ low working temperature
+ high electrode durability
+ efficient electrolyte
+ enhanced proton exchange membrance
+ novel catalytic materials, electrode materials



PEMFC stack:

+ 120W - 10 single cell
+ Working area: 250 cm^2
+ Catalyst loading: 0.4mg/cm^2
+ Power density 524mW/cm^2



$Ir_{0.7}Ru_{0.3}O_2$ catalyst

EFFICIENT AND NON-PRECIOUS (PHOTO)CATALYSTS

+ reducing noble metal in catalysts
+ organic-inorganic hybrids, 2D materials for (photo)catalysts
+ computational electrochemistry for designing novel catalysts, understand the reaction dynamics

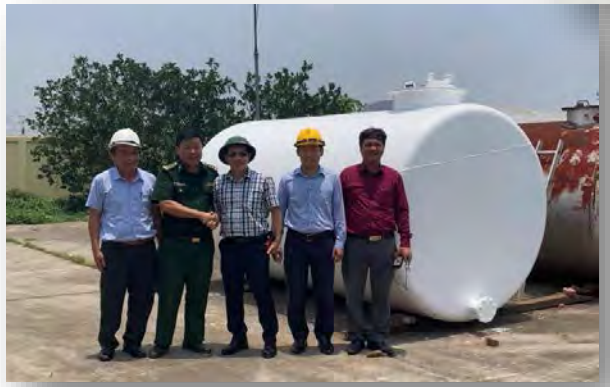
RESEARCH HIGHLIGHTS

PROTECTIVE COATINGS

SOLAR REFLECTIVE COATING

+ Solar reflectance index > 95 %.
+ Available in solvent-based and solvent-free formulations.
+ High level of weather resistance.
+ Waterproof capability.







Đề cử Top 10 sự kiện KHCN nổi bật

Câu lạc bộ Nhà báo KH&CN Việt Nam

RESEARCH HIGHLIGHTS

PROTECTIVE COATINGS









INTUMESCENT MATERIALS

+ Flame retardant paint for steel structures.
+ Flame retardant materials for electrical systems.
+ Fire-retardant paint for concrete and high-rise building ventilation systems.

RESEARCH HIGHLIGHTS

ANTIFOULING COATINGS





After 12 months of exposure

ORGANIC COATINGS SYSTEM

+ Excellent antifouling properties.
+ Excellent anticorrosion properties.

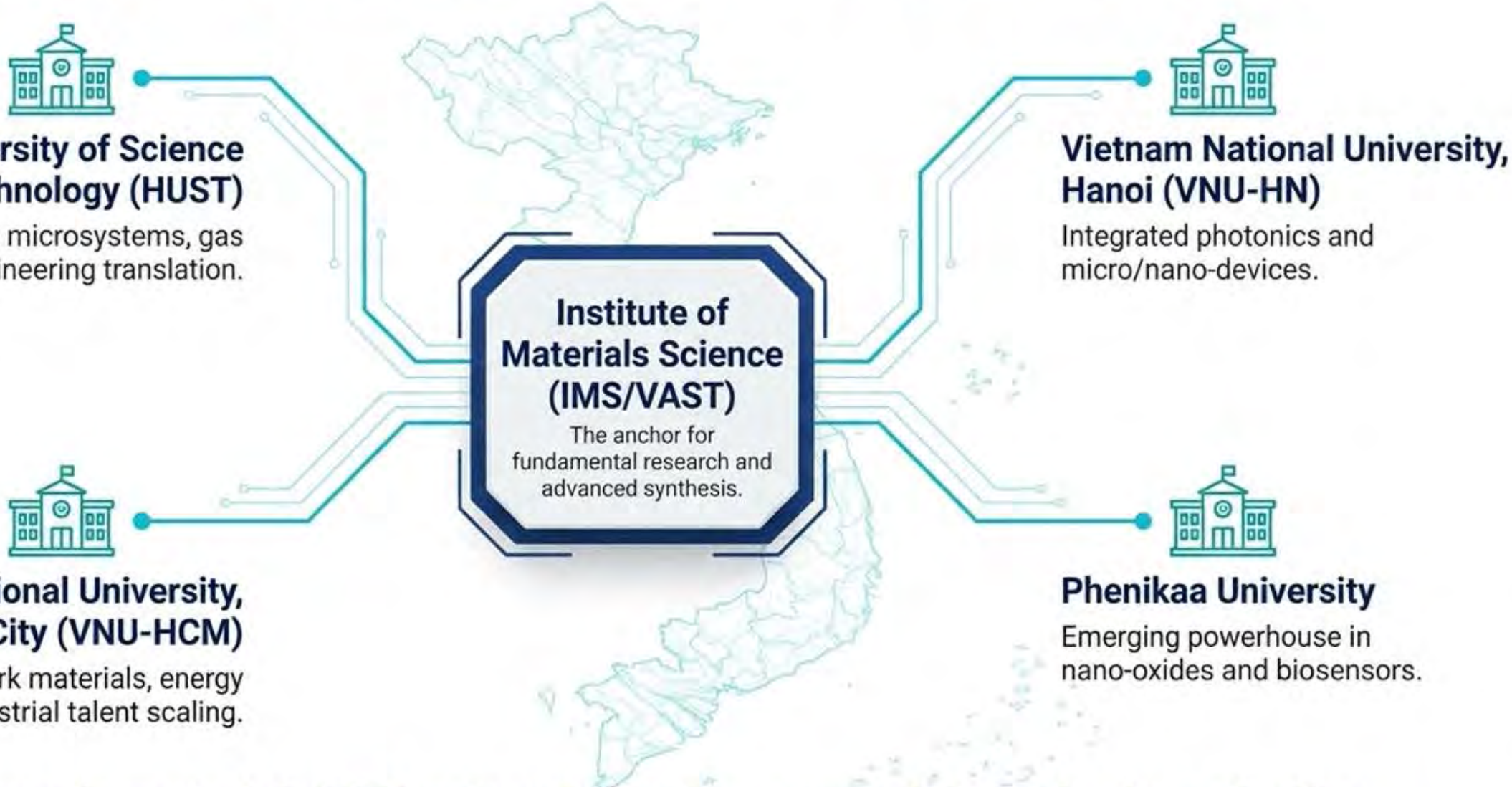




AL-MG ALLOY COATINGS

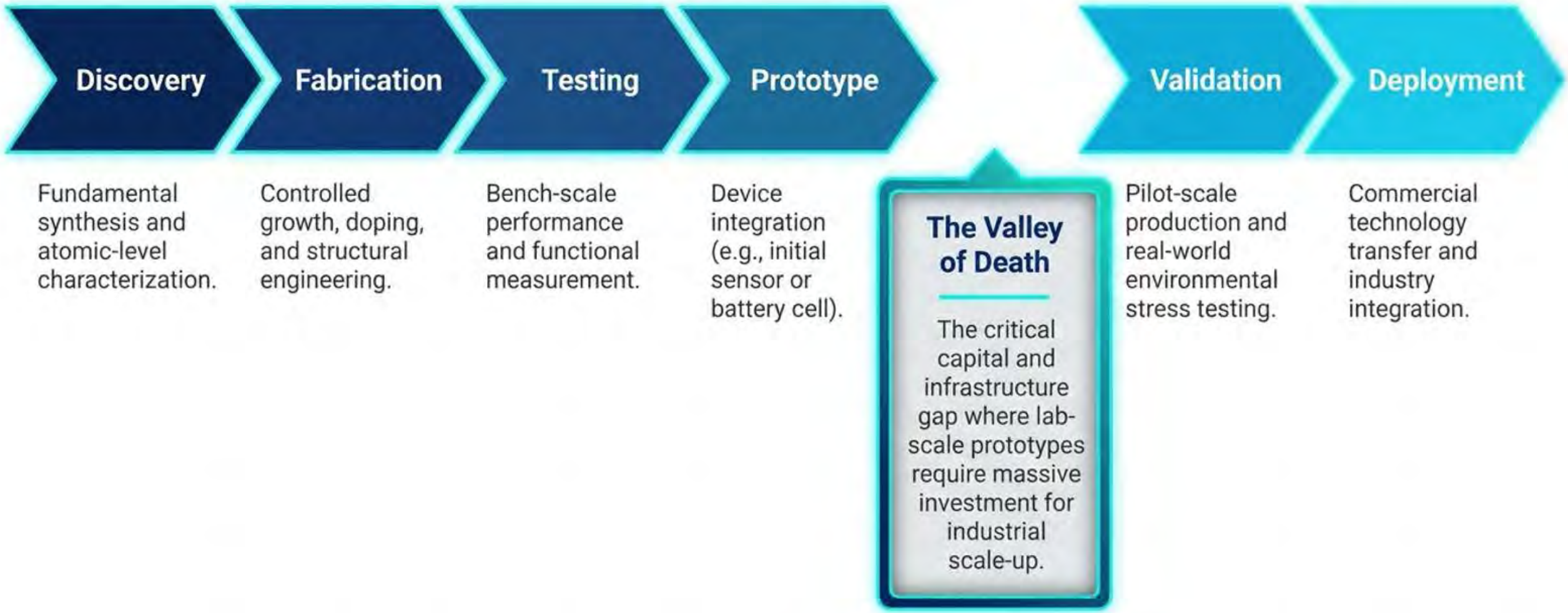
+ Excellent antifouling properties.
+ Excellent abrasion resistance.
+ Good anticorrosion properties.

A Synergistic National R&D Network

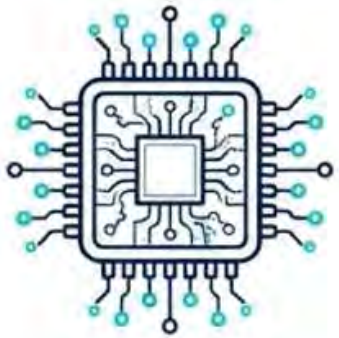


Vietnam's materials R&D network creates a complete, unbroken pipeline from atomic-level scientific discovery to industrial workforce deployment.

The Translation Pipeline From Lab to Deployment



Market Needs Dictate Application Pillars

				
Semiconductors	**Clean Energy**	**Personalized Healthcare**	**Green Agriculture**	**Environmental Remediation**
Next-generation microchips, optoelectronics, and high-frequency communication devices.	Green hydrogen production, Battery Energy Storage Systems (BESS), and precious-metal-free fuel cells.	Ultra-sensitive biosensors, targeted nanocarrier drug delivery, and rapid diagnostic kits.	Nanoformulations for crop protection, bio-coatings for export-grade preservation.	Advanced water treatment, toxin detection, and groundwater heavy-metal removal.

THANK YOU

Questions & Discussion

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