BRIN
BADAN RISET
DAN INOVASI NASIONAL

Advancing Research in Nanotechnology and Material Sciences

Ratno Nuryadi
Head of Research Organization for Nanotechnology and Materials (RONM)
National Research and Innovation Agency (BRIN), Indonesia

23 September 2025

https://brin.go.id/ornm

BRIN
BADAN RISET
DAN INOVASI NASIONAL

BRIN Head Office, Jakarta

BRIN ↦ MoRT + 4 Agencies + 44 R&D Units

- National Institute of Aeronautics and Space (LAPAN)
- Indonesia Institute of Sciences (LIPI)
- Agency for the Assessment and Application of Technology (BPPT)
- National Nuclear Energy Agency (batan)

Directions

- **Integrating research and innovation** (human, infrastructure, budget) **resources**
- Creating an open **(inclusive)** and **collaborative "global standard" research ecosystem**
- Creating **the foundation of a strong and sustained research** and innovation based economy

STEERING BOARD
Chairman: Steering Board of BPIP
Vice Chairman: MoF & Bappenas
Secretary: 1 from profesional / academics
Members: 6 persons from profesional / academics

PRESIDENT

CHAIRMAN

VICE CHAIRMAN

PRINCIPLE INSPECTOR

3 INSPECTORS

EXECUTIVE SECRETARY

5 BUREAUs

- **DEPUTY Development Policy**
- **DEPUTY R&I Policy**
- **DEPUTY Regional R&I**
- **DEPUTY R&I Infrastructure**
- **DEPUTY R&I Facilitation**
- **DEPUTY R&I Utilization**
- **DEPUTY Human Resources of S&T**

- **Data & Information Center**
- **Technology Service Center**
- **Nuclear Polytechnic**

Research Organizations

- RO Nuclear Energy
- RO Aeronautics & Space
- RO Earth Science & Maritime
- RO Life Science & Environment
- RO Agriculture & Food
- RO Health
- RO Social Science & Humanities
- RO Archeology, Linguistics & Literature
- RO Energy & Manufacture
- RO Nanotechnology & Material
- RO Governance, Economics & Public Welfare
- RO Electronics & Informatics

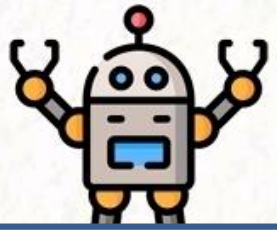
Source: Presidential Decree 78/2021

RESEARCH CENTER

BRIN
BADAN RISET
DAN INOVASI NASIONAL

Research Organization (12)

Research Center (85)



Research Organization Nanotechnology & Materials

Research Center (RC) for
1. Mineral Technology
2. Metallurgy
3. Material Energy
4. Composites and Biomaterials
5. Molecular Chemistry
6. Catalysis
7. Biomass and Bioproducts
8. Polymer Technology
9. Quantum Physics
10. Nanotechnology
11. Photonics

BRIN
BADAN RISET
DAN INOVASI NASIONAL

Head of Research Organization for Nanotechnology and Materials

Prof. Dr. Ratno Nuryadi, M.Eng.

Head of RC for Mineral Technology

Dr. Fajar Nurjaman

1

Head of RC for Metallurgy

Dr. Ika Kartika

2

Head of RC for Composites and Biomaterials

Dr. Nendar Herdianto

4

Head of RC for Molecular Chemistry

Prof. Dr. Roni Maryana

6

Head of RC for Polymer Technology

Dr. Joddy Arya Laksmono

8

Head of RC for Nanotechnology

Dr. Murni Handayani

10

Head of RC for Photonics

Prof. Dr. Isnaeni, M.Sc.

11

Head of RC for Material Energy

Dr. Sudaryanto

3

Head of RC for Catalysis

Dr. Osi Arutanti

5

Head of RC for Biomass and Bioproducts

Dr. Akbar Hanif Dawam A.

7

Head of RC for Quantum Physics

Dr. Mohammad Hamzah Fauzi

9

BRIN
BADAN RISET DAN INOVASI NASIONAL

RESEARCH CENTER FOR
MINERAL TECHNOLOGY

Dr. Fajar Nurjaman

Head of Research Center for Technology Mineral

Scope

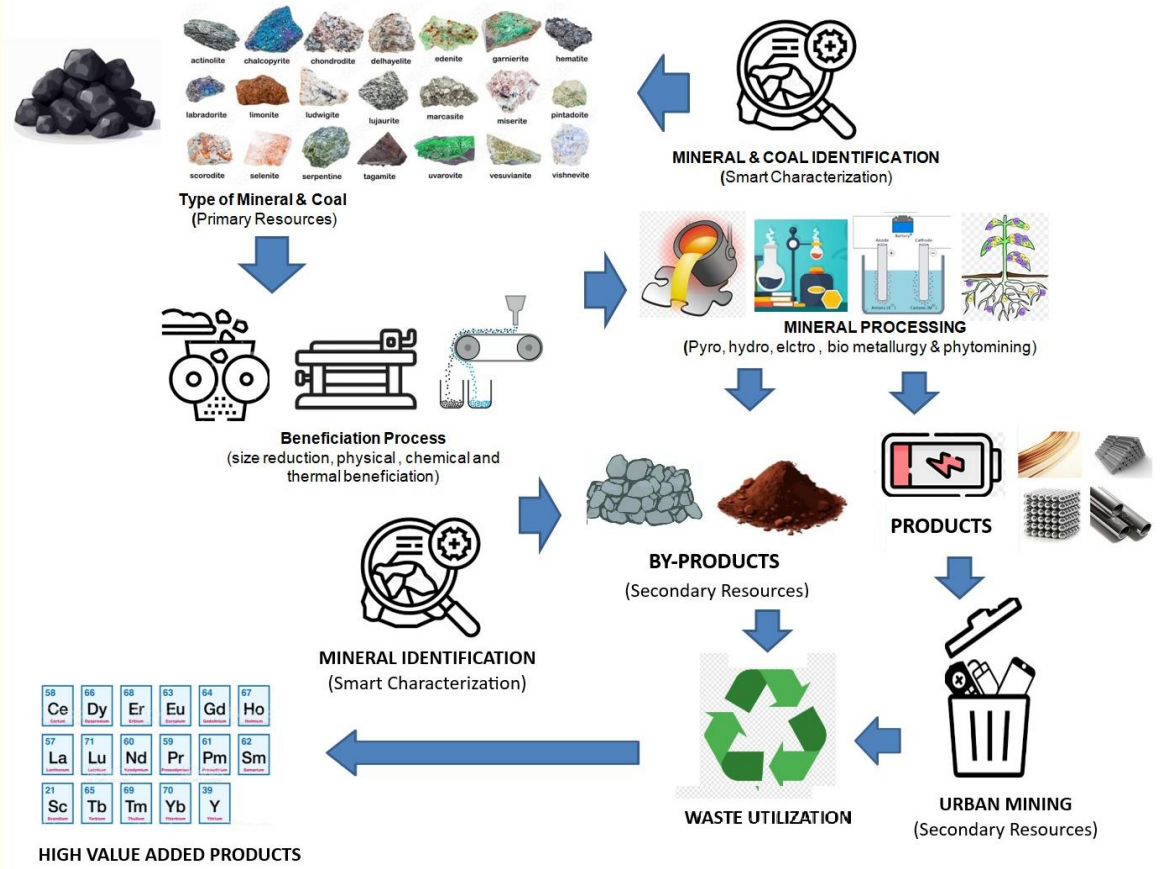
Characterization of Mineral

Mineral Processing :

- ❖Pyrometallurgy
- ❖Hydrometallurgy
- ❖Electrometallurgy
- ❖Biometallurgy

Resources:

- ❖Primary Ore
- ❖Secondary (waste)



Collaborator

Research Group

1. Smart Identification of Minerals
2. Mineral Technology of Rare Earth Elements
3. Mineral Technology of Base and Precious Metals
4. Non-Metallic Mineral Technology
5. Mineral Processing Impact Management
6. Coal Processing and Utilization

Research Members

57 Permanen staff
2 Research Fellow
12 Research Assistant
100 Students

Laboratory Equipments

Hydrometalurgi untuk REE

Submerged arc furnace

prbb@brin.go.id prbb_brin

BRIN
BADAN RISET DAN INOVASI NASIONAL

Research Center for Metallurgy

Dr. Ika Kartika, S.T., M.T.
Head of Research
Center for Metallurgy

Key Technologies

- Extractive Metallurgy
- Alloy Design & Engineering
- Advance Manufacturing
- Corrosion Control Technology

Research Group

- Metallurgical Process
- Metal Refining and Recycling
- Steel and Special Alloys
- Metallurgy Non-Ferrous Alloys
- Corrosion and Mitigation Technology

Scope

Research Products


Li2CO3


NiSO4.6H2O

Silica powder 99.99%


Environmentally Friendly Antifouling Paint


Laterite steel railway


Total hip arthroplasty


Aneurism clip


SS410 steel turbine blade

Research Members

- 45 Permanent Staff
- 22 Masters
- 23 Doctors
- 3 Bachelors

Facilities


High-Vacuum Induction Melting-Casting System


Vacuum Arc Melting

Collaborators

UPH · Siloam Hospitals · MIDC Metal and Machinery Industrial Center Balai Besar Logam dan Mesin · Curtin University · RWTH Aachen University · Swinburne University of Technology · TAM Anti Corrosion Industry · Tohoku University · Universitas Indonesia · Universitas Teknologi Bandung · Universitas Trisakti · Universitas Teknologi Sumbawa · Universitas Pertamina · PT. Agru Spesial Industri

+62 811-1933-3616
prm@brin.go.id
prm_brin

BRIN
BADAN RISET DAN INOVASI NASIONAL

PRME
Pusat Riset Material Energi

Prof. Dr. Sudaryanto, M.Eng
Head of Research Center for Energy Materials

Scope

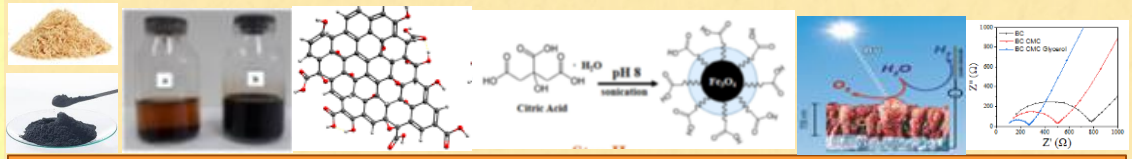
Research on materials for energy:

- ✓ generation (production),
- ✓ storage,
- ✓ conversion,
- ✓ absorption, and
- ✓ use (efficiency)

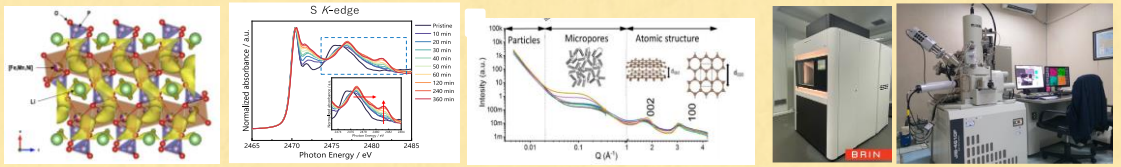
Including :

- Material Science
- Surface Engineering
- Interfacial Interaction
- Electrochemistry
- Phase Transition
- Energy Conversion
- Energy Storage
- Hydrogen Production

Key Technology



Material Synthesize and Characterizations



Advanced Characterizations

Applications

Collaborator

Reseach Groups

- Battery Materials
  - High Performance Anode Materials
  - Solid Electrolyte for Battery
  - High Performance Cathode Materials
- Magnetic and Dielectric Materials
  - Thermomagnetic Materials
  - Energy-Absorptive Magnetic Materials
- Superconductor
- Fuel Cell & Hydrogen
- Thermoelectric Materials
- Power Generator Supporting Materials

Researchers

- ❖ 62 Permanent Staff
- ❖ 1 Research fellow
- ❖ 8 Research Assistance
- ❖ 30 Students

prme@brin.go.id
prme_brin

BRIN
BADAN RISET DAN INOVASI NASIONAL

Pusat Riset Komposit dan Biomaterial

Dr. Nendar Herdianto
Head of Research Center for Composite and Biomaterials

Scope

Composite Materials

- ❑ Formulation & design
- ❑ Simulation & computation
- ❑ Fabrication & prototyping

Biomaterials

- ❑ Microstructure & biocompatibility
- ❑ Design, prototyping, testing
- ❑ 3D printing & drug delivery

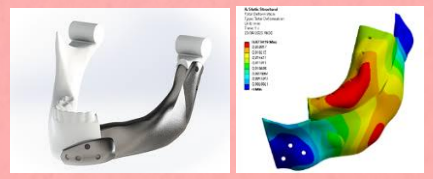
Surface Modification & Coating

- ❑ Surface engineering
- ❑ Tribology analysis

Rubber Materials

- ❑ Applications: transport, disaster, healthcare, military
- ❑ Fiber/nano-filler reinforcement
- ❑ Safe compounding tech
- ❑ Recycling

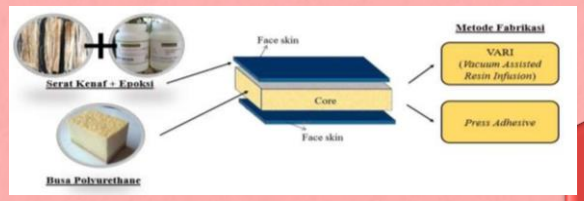
Key Technology



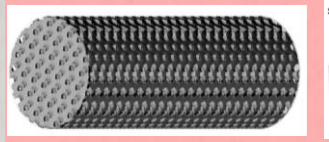
Design and simulation

Bioceramics forming technology

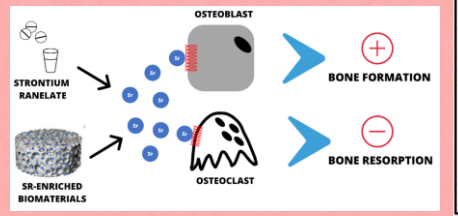
Rubber compunding



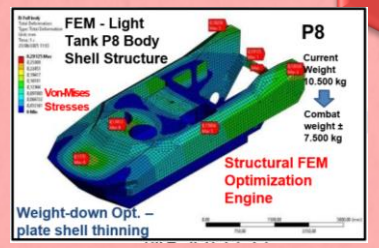
Composite fabrication technology



3D printing



Drug delivery



Computational analysis

Collaborator

Reseach Groups

- Composite Materials for Structural Application
- Biomaterials for Orthopedic and Dental Application
- Bioceramics and Biomedical Composites
- High Engineering Rubber
- Surface and Coating Technology

Researchers

- ❖ 41 Permanent Staff
- ❖ 3 Research fellow
- ❖ 8 Research Assistance
- ❖ 60 Students

BRIN
BADAN RISET DAN INOVASI NASIONAL

Research Center for Molecular Chemistry

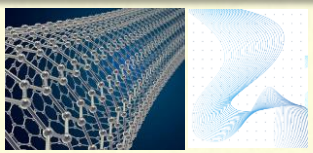
Uncover the Unknown

Prof. Roni Maryana, PhD

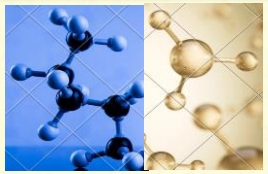
Acting Head of Research Center for Molecular Chemistry

Scope

Synthesis, Separation, and Purification



Nano Chemistry



Molecular Dynamics and Simulation

Key Technology

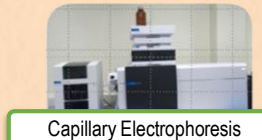
- Synthesis, modification, and functionalization of chemical compounds
- Conversion of compounds into value-added chemicals, including solvents and fine chemicals; surfactants from renewable sources
- Develop functional materials such as hydrogels, nanoparticles, and bioactive systems; electrolytes for electrochemical devices

Research Facilities

NMR

ICP-OES

ICP-MS



Capillary Electrophoresis

GC-MSD

GC

GC-MS

Collaborator

Research Groups

- Solid State Chemistry
- Fine Chemical and Bio-chemistry
- Functional Molecular Chemistry
- Analytical Chemistry
- Surface Chemistry
- Advanced Organic Chemistry
- Biochar and Adsorbent
- Surfactants and Interface Chemistry
- Functional Electrolytes and Electrochemical Process

Research Members: 57 Researchers

prkm@brin.go.id

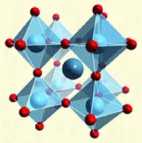
BRIN

RESEARCH CENTER FOR CATALYSIS

Dr. Eng. Osi Arutanti, M.Si

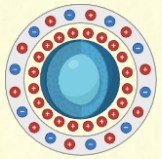
Acting Head of Research Center for Catalysis

Scope



Metal Oxide -based Catalysts

Carbon-based Catalysts



Hybrid catalysts

CLEAN WATER

STORAGE

PRODUCTION

Catysis for Sustainable Green Economy

Key Technology

Design	Purification	Fractionation	Modification
Down Sizing	Synthesize	Conversion	H_2 Production & Storage
Nanostructurization	Hybrid	Clean water	Greenprocess

Collaborator

Korea Institute of Science and Technology

UNIVERSITI MALAYA

PERTAMINA

Timah

BETEK

ÖZYEĞİN ÜNİVERSİTESİ

Science and Technology Facilities Council

ISIS Neutron and Muon Source

UNIVERSITAS INDONESIA

UIN

CHIBA UNIVERSITY

Chula Chulalongkorn University

UCL

SYNCHROTRON THAILAND

SHINSHU UNIVERSITY

SUNAN KALIJAGA YOGYAKARTA

UNNES

Research Group

- Catalysis Material Chemistry
- Molecular Catalysis
- Photocatalysis
- Sustainable Fuel Catalysis

Research Members

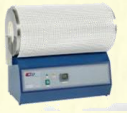
22 Permanent staff
2 Postdoctoral Fellows
7 Research Assistant
21 Students

Research Facilities

Solar Simulator

UV box reactor

Potensiostate



Tubular furnace

Box furnace

Oven

Science Wednesday (Biweekly)

pme.prkatalisis@gmail.com

pr.katalisis

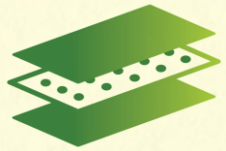
BRIN

RESEARCH CENTER FOR BIOMASS & BIOPRODUCTS

Prof. Dr. Akbar Hanif Dawam A.

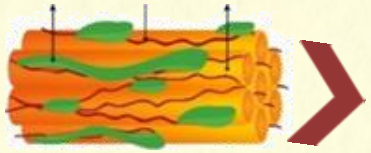
Head of Research Center for Biomass and Bioproducts

Scope



Sustainable materials

Biochemicals



Lignocellulose

Bioenergy

BIOMASS

Key Technology

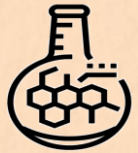
Extraction

Purification

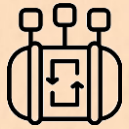
Fractionation

Modification

Down Sizing

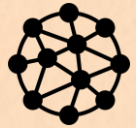


Synthesize



Pyrolysis

Digesting



Nanosizing

Hybrid

Biomimetic

Bioprocess

Collaborator

UNIVERSITÉ DE LORRAINE

KYOTO UNIVERSITY FOUNDED 1897

大阪大学 THE UNIVERSITY OF OSAKA

INSTITUT TEKNOLOGI BANDUNG 1920

USM UNIVERSITI SAINS MALAYSIA

KYUNGPOOK NATIONAL UNIVERSITY

TOMSK POLYTECHNIC UNIVERSITY

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

INSTITUT PERTANIAN BOGOR

University of Glasgow

A! Aalto-yliopisto Aalto-universitetet Aalto University

university of groningen

The University of Nottingham

Research Group

- Functional Wood
- Lignocellulose Engineering
- Nanocellulose
- Cellulose Derivatives
- Lignin-Tannin Derivatives
- Oleochemical and Extractives
- Wood adhesive and Coatings
- Green Macromolecules
- Biocarbon and Biomass Energy
- Marine Bioproducts

Research Members

75 Permanen staff
10 Research Fellow
41 Research Assistant
100 Students

Research Products

prbb@brin.go.id prbb_brin

BRIN
BADAN RISET DAN INOVASI NASIONAL

RESEARCH CENTER FOR POLYMER TECHNOLOGY

Dr. Joddy Arya Laksmono

Head of Research Center for Polymer Technology

Email: jodd001@brin.go.id

Scope

- NATURAL RESOURCES BIOPOLYMER
- SYNTHETIC POLYMER
- CARBOHYDRATE POLYMER
- ELASTOMER

- SOFT POLYMER
- POLYMER SYNTHESIS & MODIFICATION
- BLENDING & COMPOUNDING POLYMER
- GREEN & SUSTAINABLE POLYMER

Expected outcomes:

- Engineering Polymer.
- Biodegradable and Biopolymer.
- Polymer Composites.
- Advanced Rubber and Elastomer.
- Functional and Conductive Polymer.
- Coating and Film Polymer Specialty.
- Hydrogel and Superabsorbent Polymer.
- Bio-medical Polymer Engineering.
- Polymer Recyclable.
- Smart Polymer.

Key Technology

- POLYMER SYNTHESIS
- POLYMER MODIFICATION AND FUNCTIONALIZATION
- COMPOSITE BLENDING & COMPOUNDINING
- POLYMER PROCESS & MANUFACTURING
- POLYMER CHARACTERIZATION & TESTING
- ENVIRONMENTAL-FRIENDLY POLYMERS & BIOPOLYMERS
- ENVIRONMENTAL-FRIENDILY POLYMERS & BIOPOLYMERS
- SURFACE ENGINEERING & COATING

Collaborator

Universitas Negeri Jakarta; UNNES; Universitas Diponegoro Semarang; Universitas Brawijaya; Institut Teknologi Bandung; Kyoto University Founded 1897; Tokyo Tech; National Taiwan University of Science and Technology; Chung-Ang University 1916; 울산대학교 University of Ulsan; University of Malaya; Universiti Sains Malaysia

Research Group

Synthesis and Modification Polymers;

Blending and Compounding Polymer;

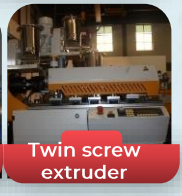
Soft Polymer and Advanced Characterization;

Green and Sustainable Polymer

Research Members

35 Permanent staff
05 Research Fellow
10 Research Assistant
50 Students

Facilities



prtpl@brin.go.id prtpl_brin

BRIN
BADAN RISET DAN INOVASI NASIONAL

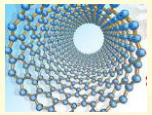
RESEARCH CENTER FOR
NANOTECHNOLOGY SYSTEM

Murni Handayani, PhD

Head of Research Center for Nanotechnology System

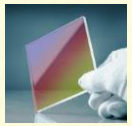
Scope

Nanofabrication and Engineering of Functional Nanomaterials



Characterization and Simulation of Nanoscale Materials

Nanomaterial electrocatalysts for energy storage, conversion, and fuel.



2D materials , nanocarbon & nanostructured membrane for photocatalyst, sensing & biomedical

Organic, Quantum Dot, Perovskite Semiconductors & thin films for Advanced Energy, Optoelectronic, and Wearable technology

Key Technology

Quantum Dots	Nanoparticles	Nanocarbons	2D Materials
Nanostructures	Semiconductor	Perovskite	Thin Films
Nanofiber & membrane	Nanoprocessing	Simulation Nanoscale	New Materials

Collaborator

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

大阪大学 THE UNIVERSITY OF OSAKA

UNIVERSITI PENDIDIKAN SULTAN IDRIS
SULTAN IDRIS EDUCATION UNIVERSITY

INSTITUT TEKNOLOGI BANDUNG 1920

Science & Technology Facilities Council
ISIS Neutron and Muon Source

cnrs

dan berbagai instansi DN...

5 Research Groups

nanoelectrochemistry research group

NANO CARBON FUNCTIONAL

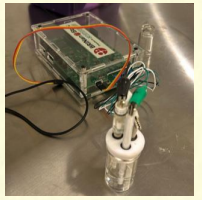
FuNS
Functional Nanostructured Semiconductors Research Group

TMFS
Thin Films & Surface Modification

Nanostructured Membrane Research group

32 Permanent Researchers

Research Products



prsn@brin.go.id

prsn_brin

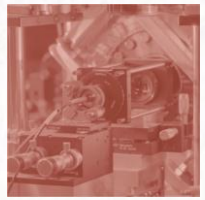
Research Center for Quantum Physics

Mohammad Hamzah Fauzi
Head of Research
Center for Quantum
Physics

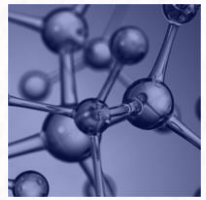
Scope

1. Quantum Sensing and Communications
2. Experimental Condensed Matter Physics
3. Experimental High Energy Physics
4. Theoretical Condensed Matter Physics
5. Quantum Information Theory
6. Theoretical High Energy Physics
7. Complex System

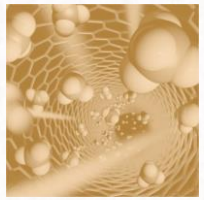
Key Technology



Quantum Optics



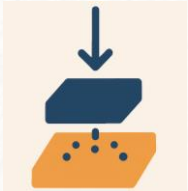
Single Crystal Growth



Computational Physics

Particle Detector

Micro/Nano Device Fab



Thin film Deposition

2D Layered Materials

Nanoparticles

Collaborator

CERN
ALICE
HIROSHIMA UNIVERSITY
KYUSHU UNIVERSITY
Universität Basel
UNIVERSITY of VIRGINIA
universität innsbruck
KANAZAWA UNIVERSITY
UNIVERSITÉ DU LUXEMBOURG
TOHOKU UNIVERSITY
Science & Technology Facilities Council
ISIS Neutron and Muon Source
diamond
cnrs

Research Group

1. Experimental High Energy Physics
2. Theoretical High Energy Physics
3. Non-Perturbative Physics
4. Quantum Matter Theory
5. Quantum Info and Computation
6. Quantum Simulation
7. Quantum Devices
8. Quantum Materials
9. Quantum Finances & Complex Systems

Research Members

38 Permanen staff
4 Research Fellow
28 Research Assistant
>50 Students

quantumresearch.id
quantum@brin.go.id

BRIN

RESEARCH CENTER FOR PHOTONICS

Prof. Dr. Isnaeni

Head of Research
Center for Photonics

Scope

- NANOPHOTONICS
- BIOPHOTONICS
- SPECTROSCOPY SENSOR - IMAGING
- INTEGRATED PHOTONICS

Key Technology

- LiDAR
- Fiber Sensors
- Laser
- Lithography
- Spectroscopy
- Semiconductor
- Nano Particles
- Photocatalys
- Bio Sensing
- Biophotonics
- Control
- AI

Collaborator

- National: UI, ITB, UGM, UNHAS UB, etc
- International: Tohoku, HKUST, KAIST, USM, UTM, etc

Research Group

1. Optical Instrumentastions
2. Optodinamic Sensors
3. Nanoplasmonik Technology
4. Control and Precision Measurements
5. Micro-Optical-Electrical-Mechanical System
6. Semiconductor Photofunctional Materials
7. Laser-Assisted Material Process and Spectroscopy

Research Members

43 Permanen staff
2 Research Fellow
13 Research Assistant
60 Students

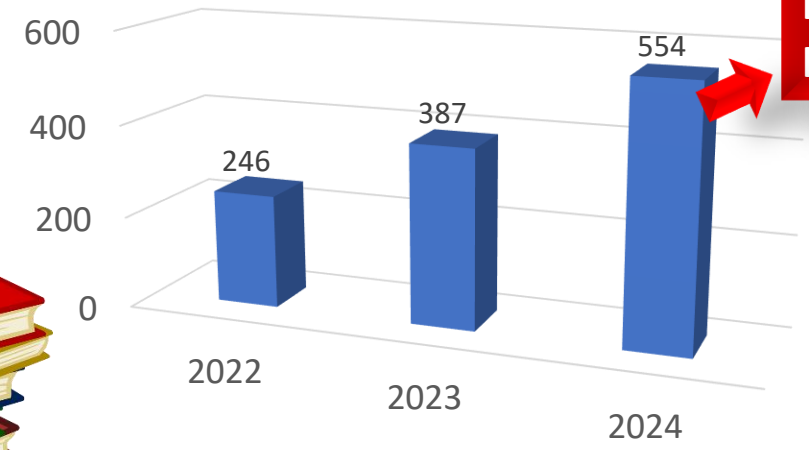
Research Products

- Water flow speed, direction, and quality monitor
- Phototherapy technology
- Weigh-in-motion vehicle sensor
- Nanogold for health

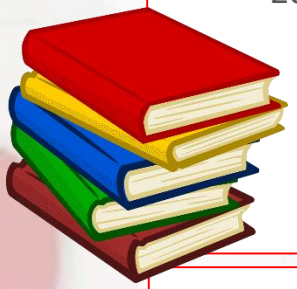
prf@brin.go.id +62 811-1933-3620

Research Ouputs in 2022-2024

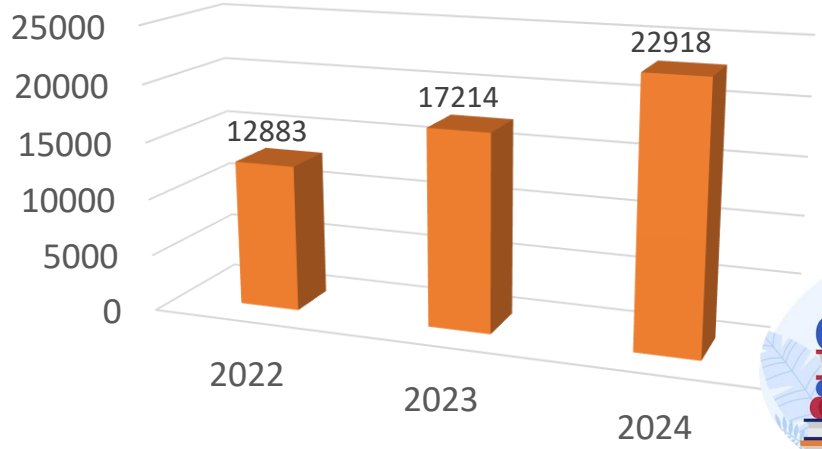
International Journals Q1 dan Q2

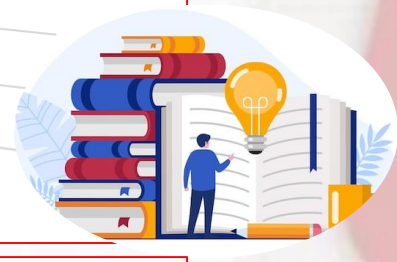


IF >20 =6
IF 10-20 =16

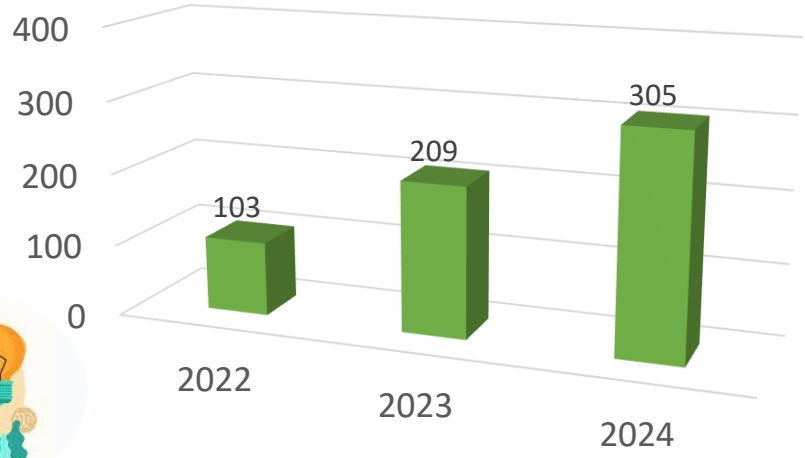


Publication Citations (Scopus)

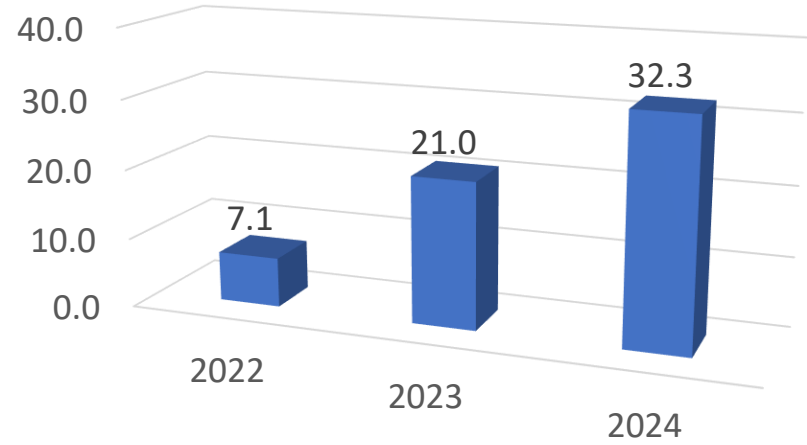




Intelectual Properties (Patent, etc.)



External Funding (Rp. Billion)



Researcher Mobilities : 2022-2025

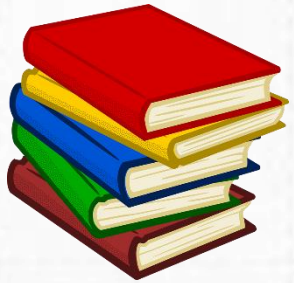
508 Researchers

180+ postdoctoral/
Visiting Researchers

Degree-by-Research
Students (MSc/PhD)

390+

310+
Research
Assistant
(MSc/PhD)



1440+
International Journals Q1&Q2

70.700+
Publication
Citation

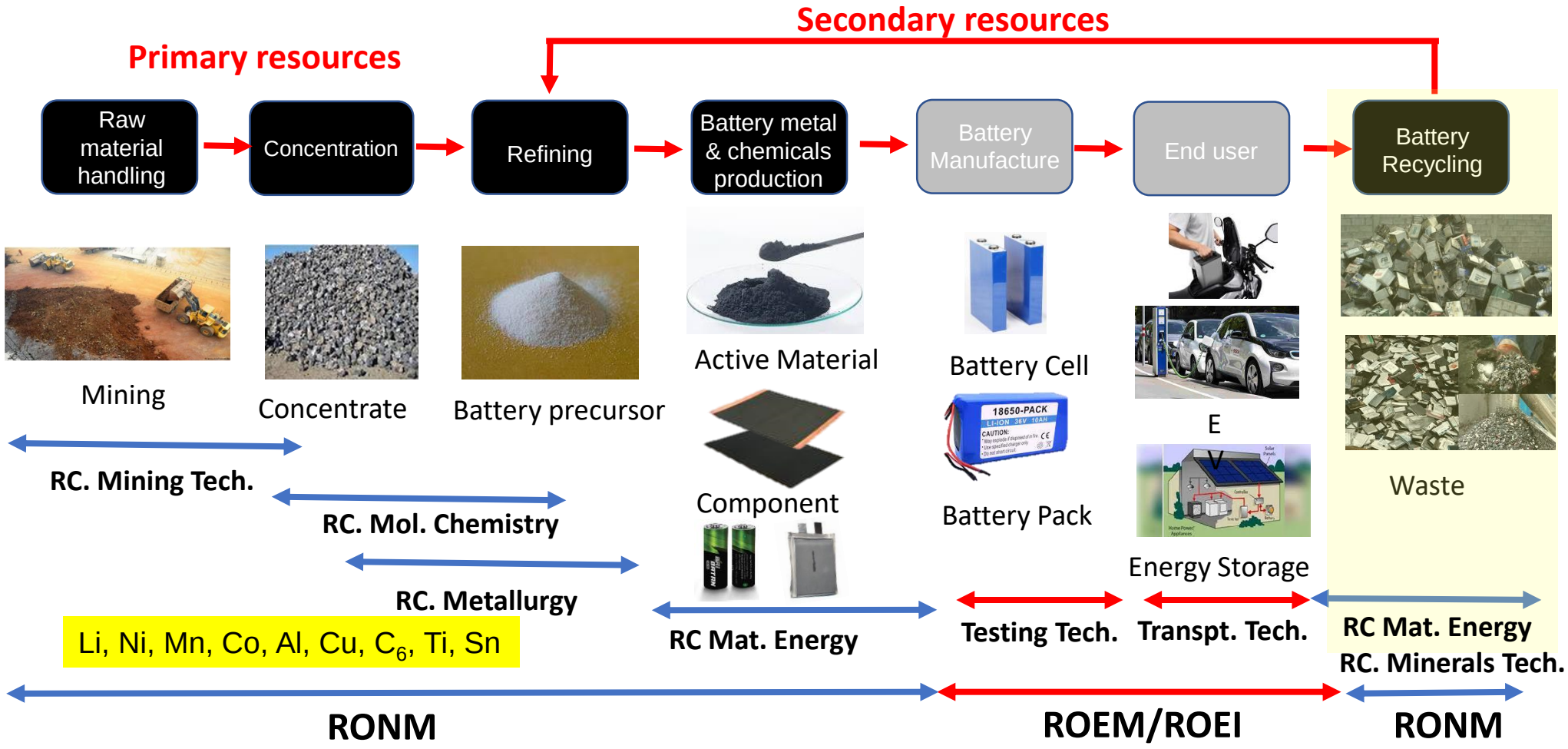
720+
Intellectual Properties

Selected Research Activities
- Examples -

BRIN
BADAN RISET
DAN INOVASI NASIONAL

1

Research Activities on Li-Ion Battery (LIB) in BRIN



ROEM = RO Energy and Manufacture
ROEI = RO Electronics and Informatics

2 Battery Precursor Synthesis Process : Lithium-Nickel-Manganese-Cobalt (Li-NMC)

Primary Sources

Nickel laterite Ore

Bijih Mangan

Geothermal Mud

Secondary Sources

Spent batteries

Spent catalysts

Leaching Reagent

Comminution (Sizing) → Chemical leaching → Solid-liquid filtration → Pregnant leaching solution → Purification and Crystalization

Solid residue

Synthesis and Characterizations :

1. Comminution equipment: jaw crusher, ball mill, sieving machine, oven
2. Leaching equipment: leaching tank, laboratory reactor, hot plate stirrer, glassware
3. Solid-liquid separation equipment: hot press filter
4. Purification and crystallization equipment: solvent extraction system equipment, separating funnel, oven, pH meter
5. Characterization equipment: ICP OES, XRD, XRF, SEM-EDS, FTIR

Precursor Products (Senyawa Ni, Co, Mn, Li)

Cobalt

Nickel

Lithium

Mangan

3 Laterite Nickel Processing with *Selective Reduction Process*

1,9 Ni - 22,36 Fe

+ Reductant
(No-additives)

No.	Berat Briket Bijih Nikel Laterit (gr)	
	Sebelum Reduksi	Setelah Reduksi
Rerata (gr)	109,31	79,22
Selisih (gr)	30,09	
% Losses	28%	

Berat Awal	Berat Briket Sponge (gr)	
	Magnetic	Non-Magnetic
% Berat	32%	68%

Selective Reduction Process :

- ✓ Moderate temperature process
- ✓ Low-cost energy (compared with BF Smelter)
- ✓ Various reductant can be used (no-cokes required)
- ✓ High Ni-grade in ferronickel

Temperature 1100-1200°C
Preheat 4 hours
Reduction time 1 hour

Magnetic 3.71 Ni – 89.76 Fe

4 Development of Coal-Coalite Processing Technology into Artificial Graphite and Pilot-Scale Anode Sheets

BRIN Badan Riset dan Inovasi Nasional · BukitAsam

Artificial Graphite

Synthetic graphite is made from amorphous carbon using the following process:

1 High temperature graphitization, 2 pyrolysis with the help of a catalyst, 3 hot isostatic pressing, 4 CVD of hydrocarbons at high temperature.

Advantages of AG over Natural Graphite: 1 Better cycling stability, 2 Better fast charging performance, 3 Higher quality consistency

Anode Sheet

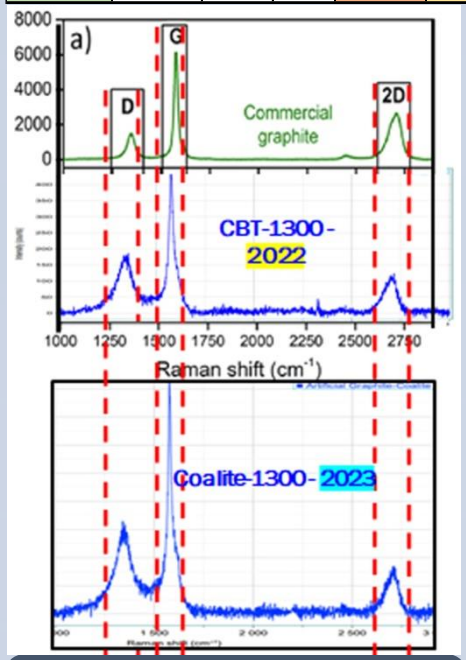
Green Product

The electrode is in the form of a sheet made from copper foil coated with graphite carbon on the sides and is used as an anode for Li-ion batteries.

This product is a Green Product because it uses a water-based formula

Quantitative XRD analysis

Lorentzian Function	Sampel	2 theta (deg)	theta (deg)	d-spacing (Å)	DoG (%)	FWHM (deg)	Lc (Å)	n
Grafit C002	CBT-1300	26,56	13,28	3,36	96,87	0,19	425,39	126,73

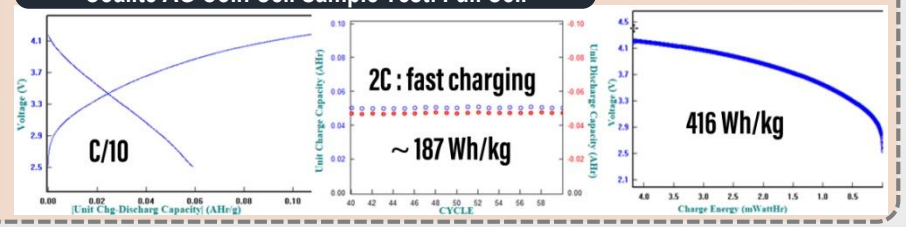


Raman results

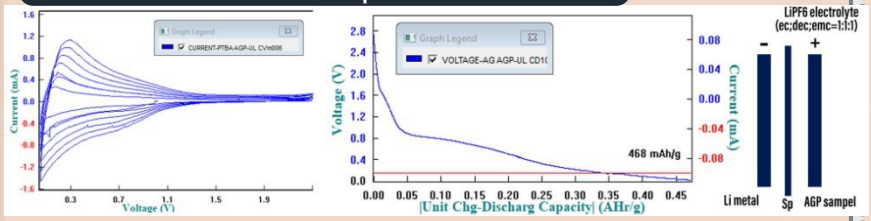
Raman results show a higher Ig peak compared to Id. Id/Ig << 1, indicating a good degree of graphitization. This is indicated by the CV test which has a peak oxidation voltage of around 0.3 V.

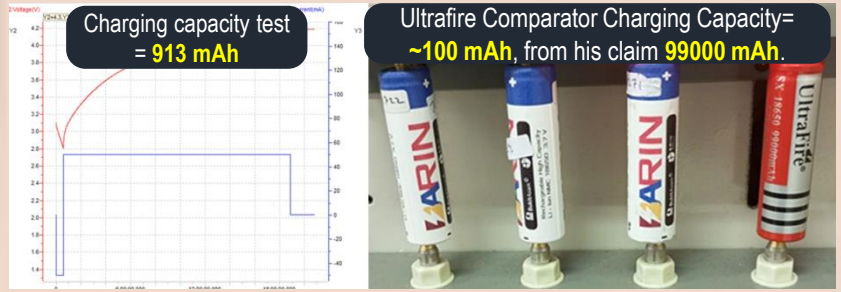
Coalite Product Diversification

Coalite AG Coin Cell Sample Test: Full Cell



Coalite AG Coin Cell Sample Test : Half Cell





Advantages

- High graphite structure match up to **96.8%**.
- First discharge capacity 478 mAh/g, higher than commercial MCMB (372 mAh/g)
- Full-cell test with LiNMC: energy density 416 Wh/kg (0.1C), and 187 Wh/kg (45%) at 2C.
- 18650 cells show 1200–1500 mAh capacity (still limited by slurry, coating, and assembly process).
- Fast-charging (2C) delivers 187 Wh/kg for 50 cycles, with normal charging up to 400 Wh/kg.

5 Lithium Batteries and Supercapacitors

Integrated Battery Lab

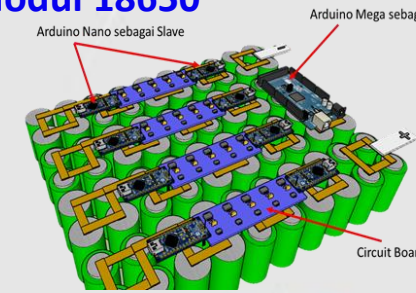
PT Industri BSN

NMC + BMS

NMC Battery Pack:
- Pack Capacity: 20 Ah
- Nominal Voltage: 72 V

Testing Target (1C):
- Charging current: max. 20 A
- Discharging current: max. 40 A

Battery Modul 18650

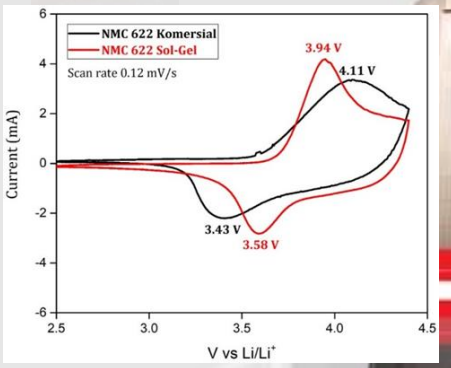


LTO

LTO Battery Pack:
- Pack Capacity: 20 Ah
- Nominal Voltage: 72 V

Testing Target (2C):
- Charging current: max. 50 A
- Discharging current: max. 200 A

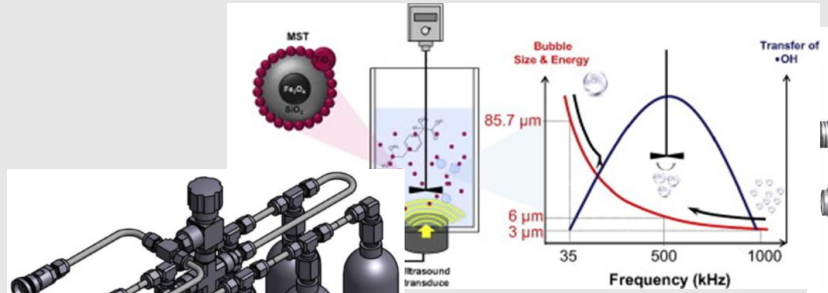
Test Result (1.5C):
- Charge: 16.618 Ah
- Discharge: 18.056 Ah
- Charging time: 33.27 min.
- Discharging time: 36.23 min.

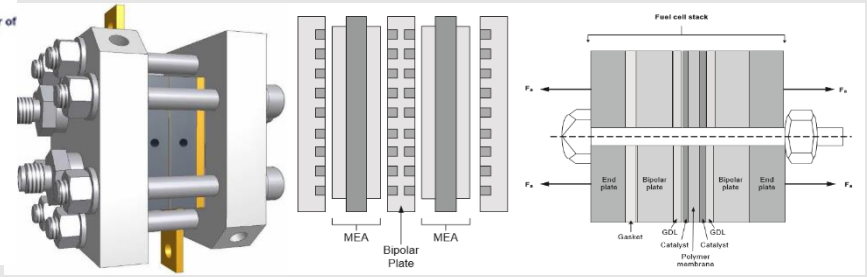


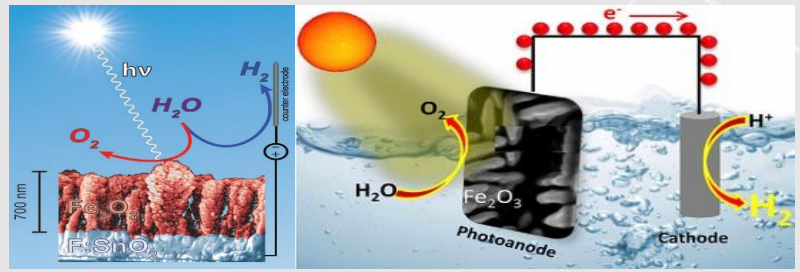
6 Fuel Cell and Hydrogen

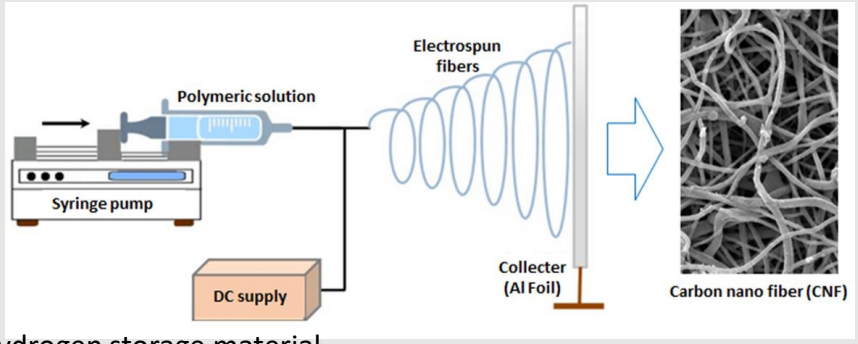
Energy conversion materials includes 1) Synthesis and characterization of anode, cathode and fuel cell electrolyte materials; 2) Membrane electrode assembly, stacking, simulation and fuel cell performance test system; 3) Development of hydrogen technology materials (green hydrogen) and oxygen purification.

Dev. Material for Fuel cell (bipolar plate, GDL, End plate

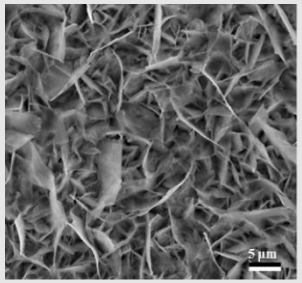


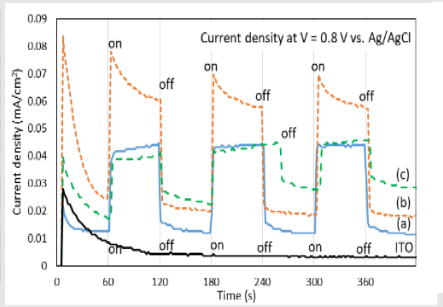


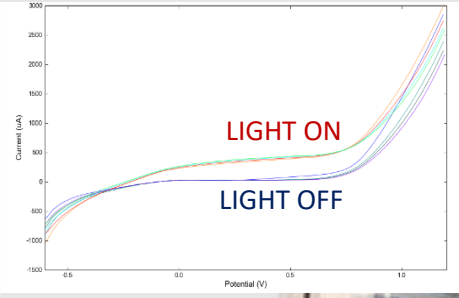




Carbonaceous based hydrogen storage material







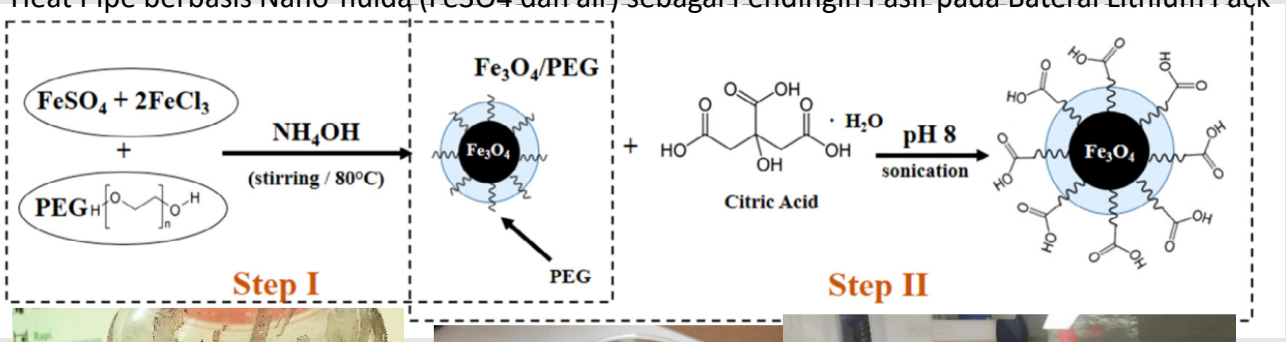
Dev. Fe2O3 and ZnO photoanode for photoelectrochemical water splitting (PEC)

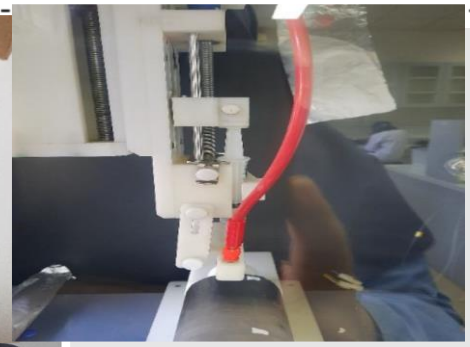
Collaborations :

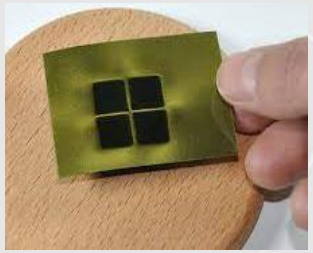
PT Krakatau Steel, PT Graphene Nanomaterial, PT Kirana Mitra Abadi
Rajeev Gandhi Mem. Coll of Eng. Tech. India

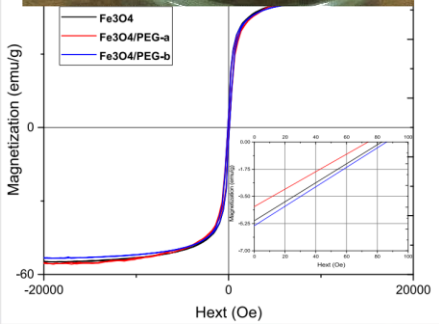
7 Magnetic and Spintronic Materials

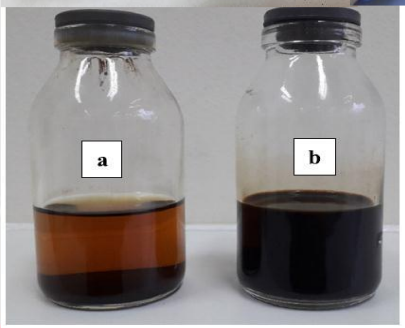
Heat Pipe berbasis Nano-fluida (Fe3O4 dan air) sebagai Pendingin Pasif pada Baterai Lithium Pack











Development of Magnetite Fe3O4 Nanowire as Lithium Battery Electrodes

Collaborations : Chungbuk National University- Korea, Universitas Sumatera Utara, Universitas Pamulang, Universitas Indonesia, PT. Sigma Paint, PT. PINDAD

BRIN
BADAN RISET
DAN INOVASI NASIONAL

8

Battery Recycling : Piro-Hydrometallurgy (Scale Up Trials)

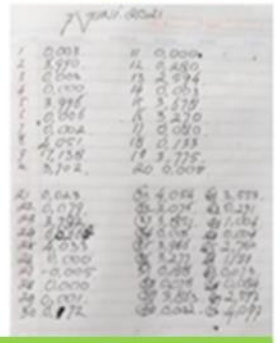
Preparation (Lab Scale)

pelletization

Leaching

Scale Up Trials

Dismantling

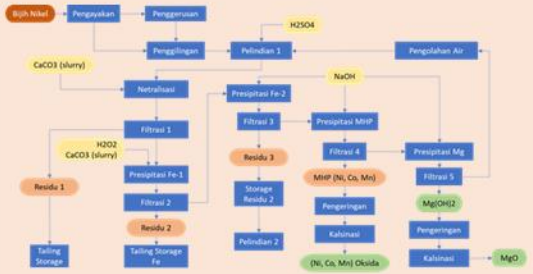


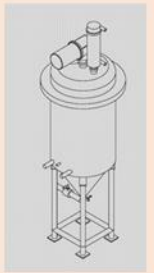
potential difference measurement

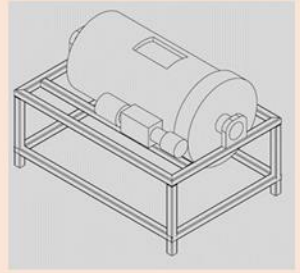
Scale Up Trials

Preparation and battery Roasting

Black Mass leaching and crystallization





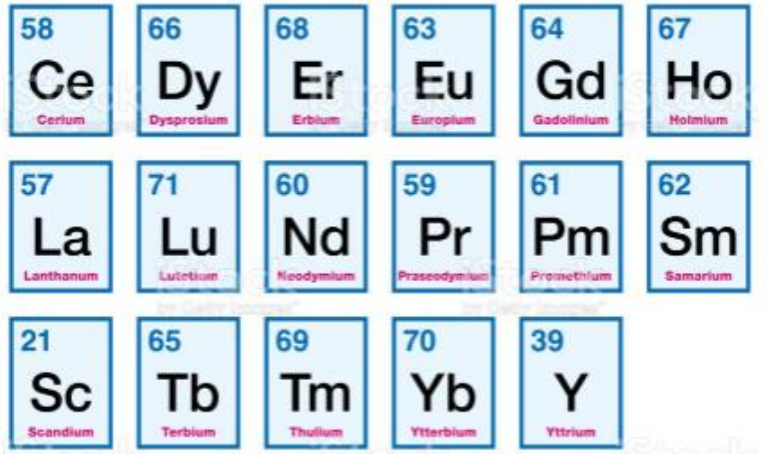


Basic Design and FEED

- Leaching with H_2SO_4, temperature 50 - 85°C for 4 hours with Ni and Co solubility levels of more than 90%.
- Pregnant Leach Solution (PLS) was precipitated and crystallized to produce a mixture of crystalline (Ni,Co, Mn)SO_4 as a precursor for battery raw materials
- Basic design for hydrometallurgical step including process flow and main equipments

BRIN
BADAN RISET
DAN INOVASI NASIONAL

9 Research in Rare Earth Minerals



Research Center for Mining Technology

- ✓ REE from monazite
- ✓ REE from secondary resources & industrial waste
- ✓ REE from ion adsorption clay

Research Center for Metallurgy

- ✓ Light metals-rare earth alloy reduction/oxidation behavior
- ✓ Extraction of REE from bauxite using deep eutectic solvent

Research Center for Materials Energy

- ✓ Improvement of LNMO Battery Cathode Performance using REE
- ✓ Performance Improvement of Nickel-Rich NMC Lithium Ion Battery Cathode with REE

10 Development of Environmentally Friendly Antifouling Paint Based on Cerium Oxide Nanoparticles

BRIN
BADAN RISET DAN INOVASI NASIONAL

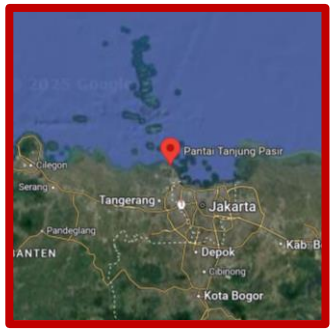
CeO2 nanoparticles (0, 0.1, 0.3, 0.5% wt)

Antifouling Paint without toxic co-biocide from local paint manufacturer

Environmentally Friendly Antifouling Paint Prototype

Baja Karbon Rendah
50 x 50 x 1 mm

Field Test

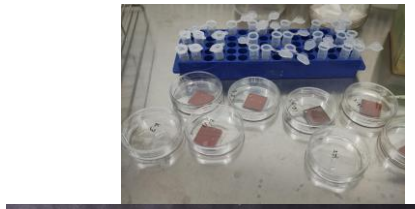


Tanjung Pasir, Tangerang

Removed from seawater on 1, 4, 9, and 12 month and investigated the fouling rate

Leaching-out test

Antibacterial test



Supported by :
UI, Untirta, PT. TAM Victory Cemerlang

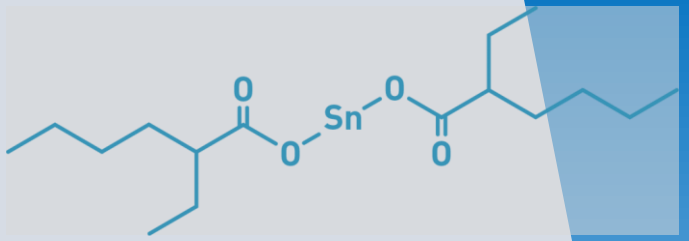
11 Development of Biochar Based on Palm Oil Biomass and Its Derivative Products

Energy and Environment Research Center, Institute for Advanced Engineering (IAE) Republic of Korea	•Collaboration in the field of research and development of biochar based on oil palm biomass and its derivative products.
PT. Dharma Satya Nusantara Tbk dan PT. Astra Agro Lestari Tbk	- Research collaboration to obtain primary data on reducing sugar potential and yield in SAP juice from oil palm replanting in East Kalimantan. - Bioethanol G2 production study using BTS and TKS biomass.
PT SEMEN INDONESIA (PERSERO) Tbk	- Collaboration on data mapping and formulation of chemical additives for cement and concrete. - Development from laboratory prototypes to pilot plant production.
Universitas Gadjah Mada, PT Geo Dipa Energi, dan Unconventional Geo-Resource Research Group	•Collaboration aimed at developing a prototype pilot plant for nanosilica.

BRIN BADAN RISET DAN INOVASI NASIONAL

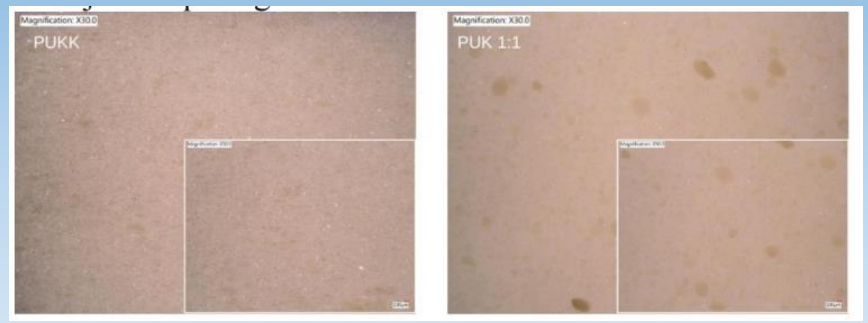
IAE Institute for Advanced Engineering SIG DSN GROUP PT Geo Dipa Energi (Persero) UNCONVENTIONAL GEO-RESOURCES RESEARCH GROUP Research Center for Molecular Chemistry Uncover the Unknown

12 Research and Development of Stannous Octoate Catalysts for Polyurethane Foam Production



Stannous Octoate Products

Polyurethane foam results



Foam morphology with commercial and synthetic stannous octoate products

Partner Industri:

TIMAH
PT TIMAH INDUSTRI

Contact Person:
Dr. Kiky Corneliasari Sembiring, M.Eng
Pusat Riset Katalisis
081210376550; kiky001@brin.go.id

Sn

PUSAT KOLABORASI RISET LOGAM TIMAH

Research on Supporting Materials for Power Plants (Coating Materials)

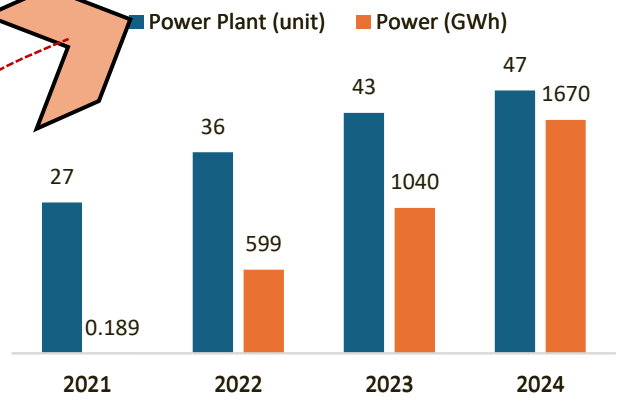
2. Renewable Energy

Renewable Energy Increase Target: 23% by 2025, 31% by 2050(2020 National Energy Mix Book, DEN)

1. Reducing Greenhouse Gas Emissions

Indonesia: Cease coal-fired power plant operations by 2040 (COP-26 Climate Summit (Oct-Nov 2021))

The Development of Co-firing in Indonesia



10% biomass (wood pellets)→ Reduces greenhouse gas emissions by 9% (Morrison B and Golden J.S, 2017)

Batubara-biomassa menyebabkan degradasi material hingga 14%
(Karuana et al, 2023)

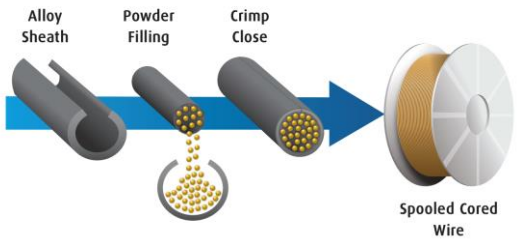
Research achievements

Industry and University Collaboration

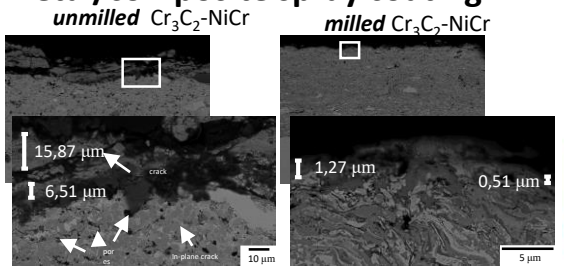
Domestic component level

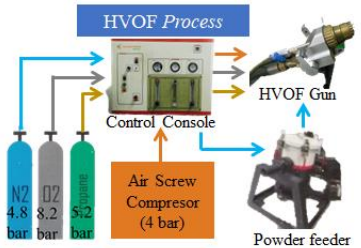
Slurry coating

Core wire spray coating



Metal/composite spray coating





Lignin-based adhesives (Lignin-phenol-formaldehyde, LPF resins)

BRIN BADAN RISET DAN INOVASI NASIONAL

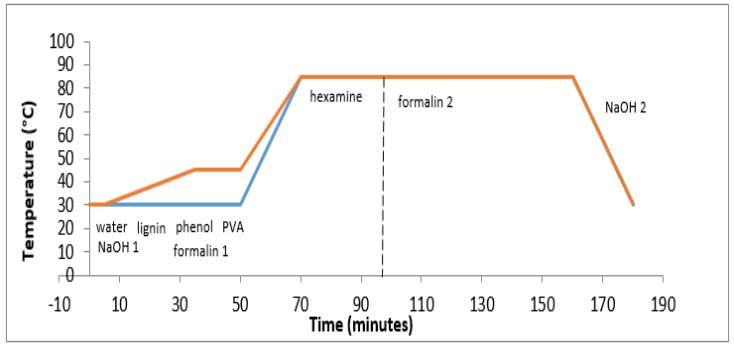
PT. DOVER CHEMICAL

1. Developed Material: Lignin-based Adhesive (Lignin-phenol-formaldehyde, LPF resins)
2. PI: Prof. Adi Santoso
3. Stage: Lab-scale trials (capacity 300 ml & 3000 liters)
4. Status: In progress (lab-scale adhesive synthesis/formulation and testing for plywood applications)

LPF resins formulation

Item	conc	LPF	
		gram	%
lignin	65%	900,3	30%
Heksamine	100%	4,0	0,1%
phenol	94%	230,0	7,7%
PVA		5,0	0,2%
CMC sol		0	0%
NaOH	48%	110	3,7%
Formalin	37%	900,0	30,0%
H2O		850,28	28,3%
Total		3000	100%

LPF resins synthesis process



PRBB Team dan RnD Dover

Adhesive synthesis

Adhesive prototype

Plywood applications

15 Development of Bone Implants and Dental Implants

Bone Implant Development

- ❑ Development of surface engineering for traumatic implants via anodizing and sealing; results under patent, ready for industry use by PT. Zenith Allmart Precisindo.
- ❑ Clinical trial support for spinal implants funded by BRIN–LPDP; company and CRO negotiating with RSCM for trials on 18 subjects under Ministry of Health approval (PPUK).

Traumatic Implants

Spinal Implants

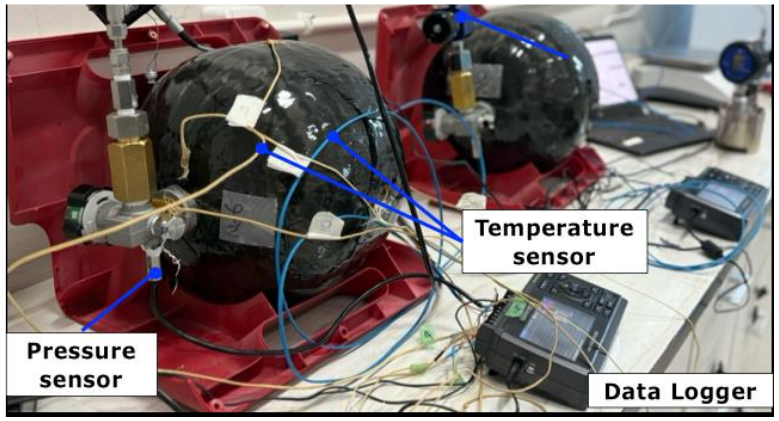
Dental Implant Development

- ❑ Development of dental implant cleaning technology before sterilization; supporting CPAKB certification process.
- ❑ Collaboration with PT. Pudak Scientifik on hydroxyapatite coating technology for pure titanium dental implant fixtures to enhance osseointegration; current stage involves thermal coating on titanium samples.

Dental Implants

Osseointegration characteristics of implant fixtures in rabbit bones

Co-Development (Bio)Methane Storage: Preparation of Adsorbent-based MOF and Cylinder-based Polymer Composite



Result and Comparison with C-Cyl

Specs	CubiTan	C-Cyl
Tank weight (kg)	11.7	30.5
Volume water capacity (L)	10	17
Pressure (bar)	80	200
CNG storage amount (g)	1530	2005
CNG density (g_{Gas}/kg_{Tank})	131	66
CNG density (g_{Gas}/L_{Tank})	153	118

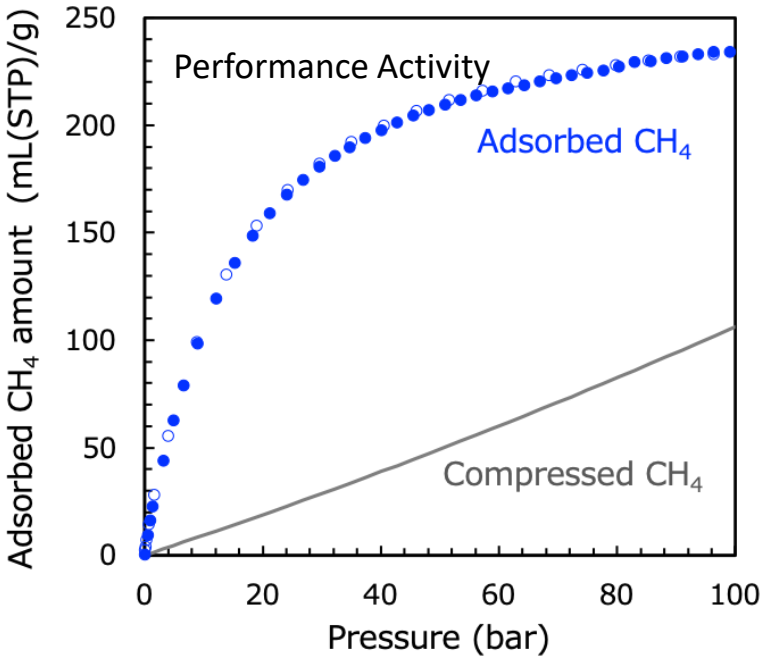
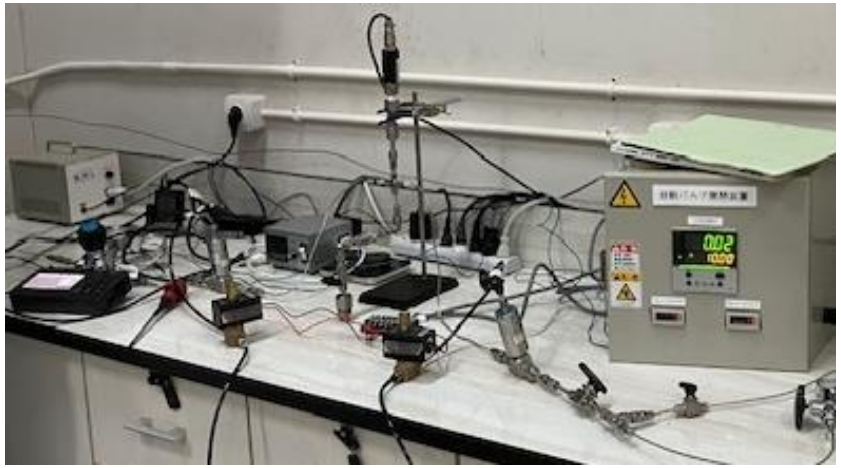
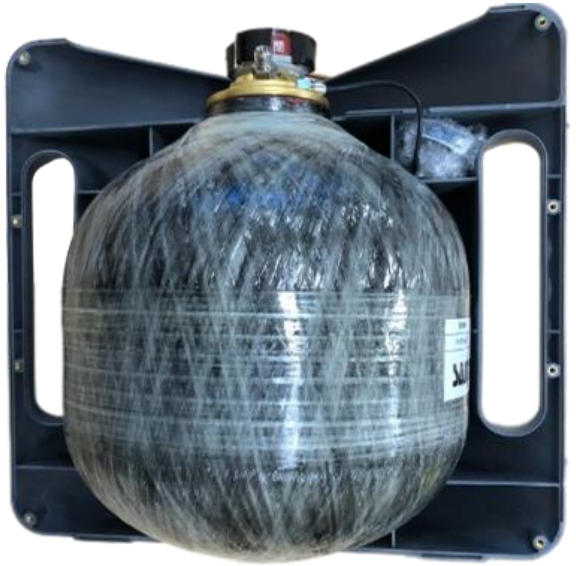


Photo of the cycle test





High-Pressure Gas Cylinder (CFRP)

17

BIODEGRADABLE BIOPLASTIC MATERIAL (EASY TO DECOMPOSE)

1 TECHNOLOGY DESCRIPTION

Bioplastic is a plastic material produced from renewable natural resources and is naturally biodegradable. This material is designed to replace petroleum-based plastics, whose raw materials are increasingly limited and which contribute to environmental pollution.

2 ROADMAP

2022: Thermoplastic Starch (TPS) bioplastic
2023: Seaweed-based bioplastic
2024: Polyhydroxybutyrate (PHB) bioplastic
2025: Polylactic Acid (PLA) bioplastic

3 COLLABORATORS

PT. Evoware (PT Evogaia Karya Indonesia)
PT. ATMI IGI: Development of printed bioplastic products
PT. Galic Artabahari

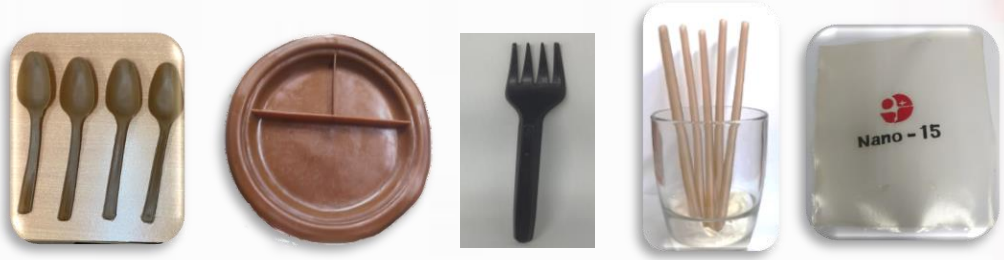
4 ADVANTAGES

The resulting bioplastic has mechanical properties (tensile strength and elastic modulus) competitive with commercial synthetic plastics. Furthermore, it degrades rapidly in nature, contributing to reduced carbon emissions. It is designed for production using conventional, widely available industrial molding machines, enabling large-scale application.

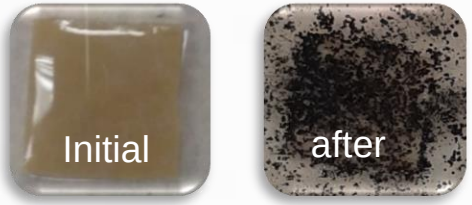
For sustainable future

Raw materials from renewable biomass

Bioplastic material in the form of pellets



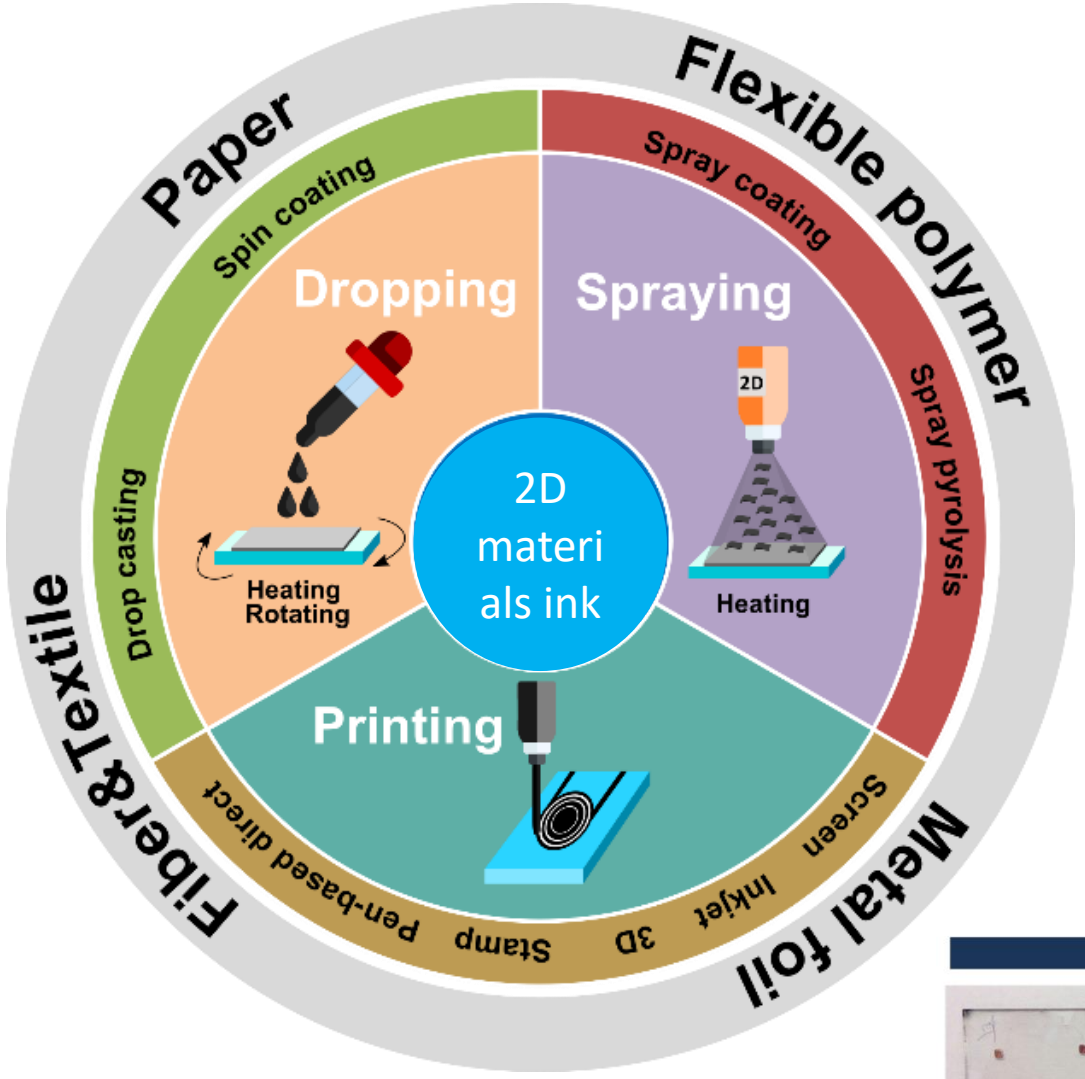
Examples of single-use bioplastic products

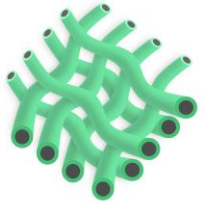


Bioplastic is eaten by soil microorganisms (aspergillus niger sp.) after 21 days

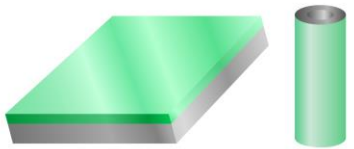
Biodegradable test

Deposition of 2D materials on various substrates

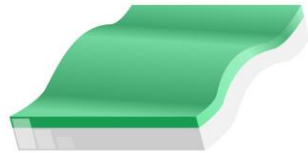




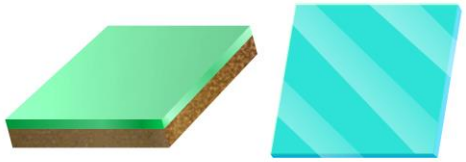
Textiles and Fibers



Metals and Alloys

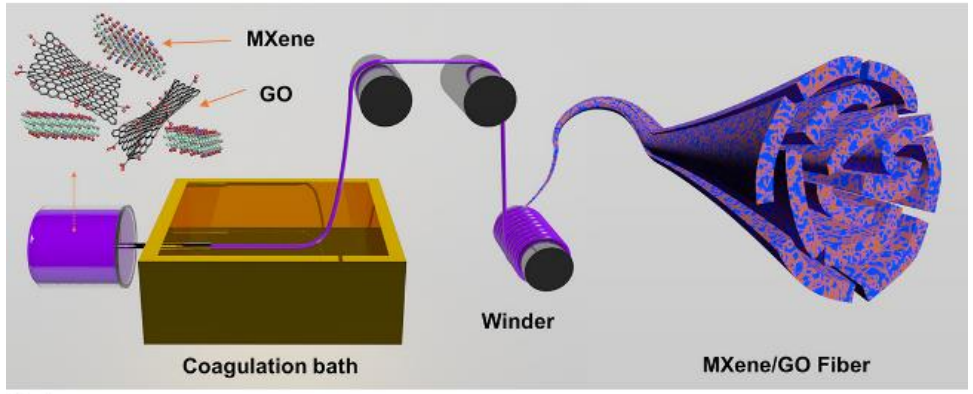


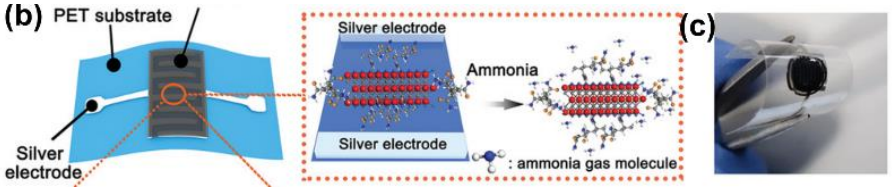
Polymers and Plastics



Ceramics and Glasses

Papers

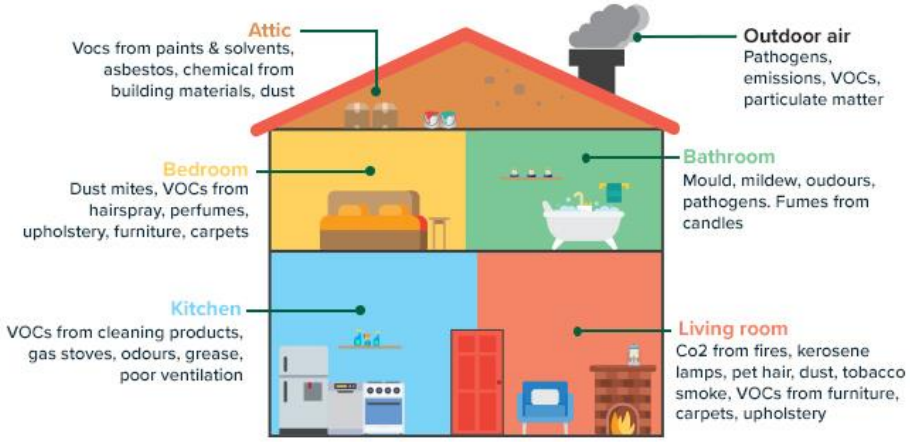


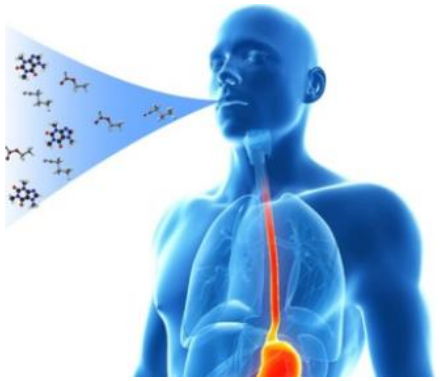


A. Hermawan, et al. Adv. Healthcare Mater. 2021,

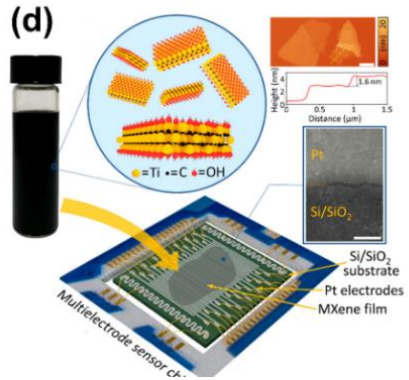
2D Materials for gas sensing

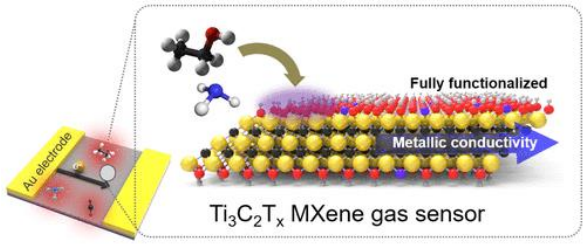
BRIN
BADAN RISET
DAN INOVASI NASIONAL

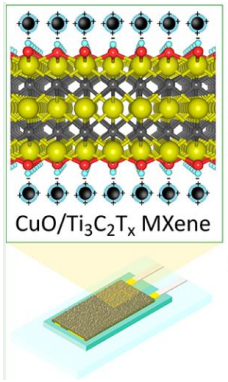


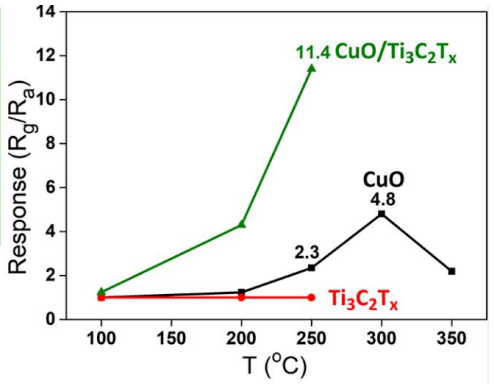


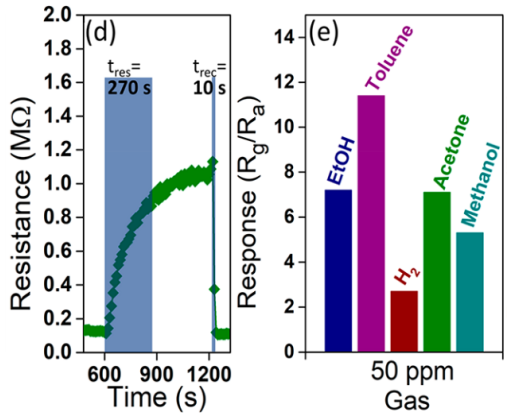
Health problems

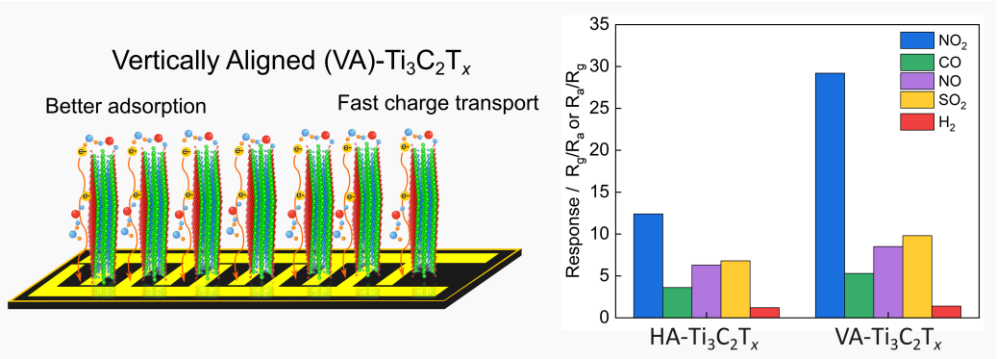


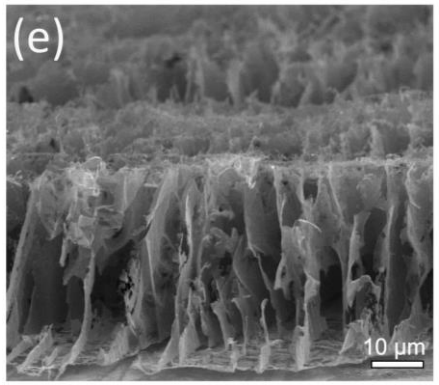


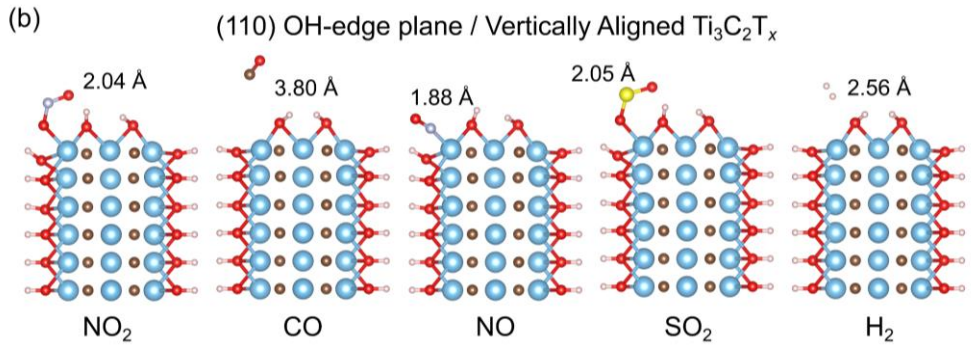






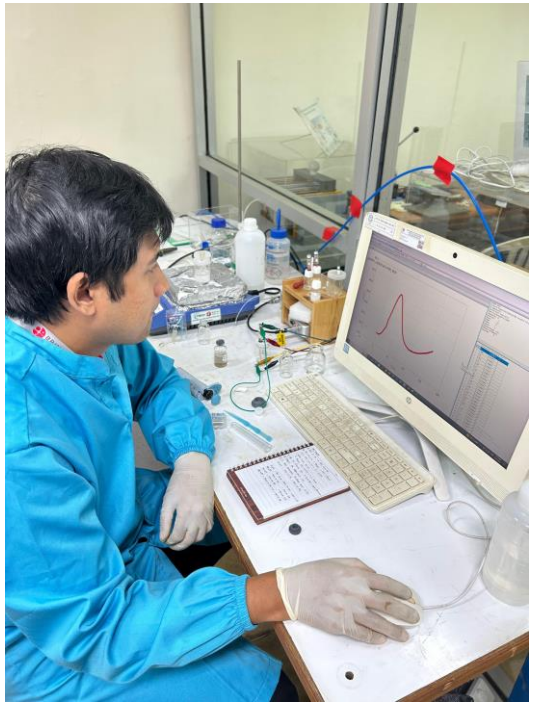


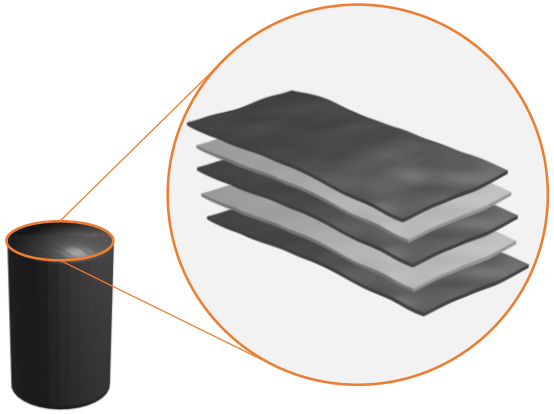


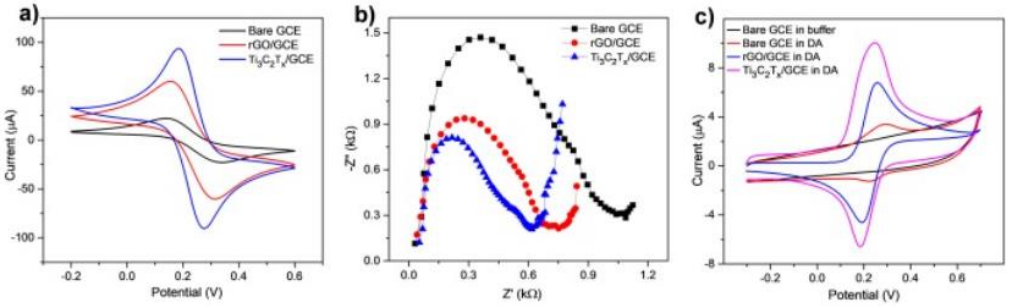


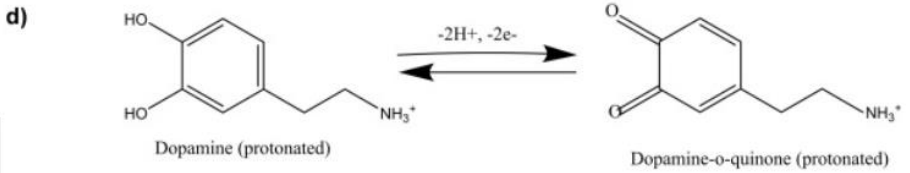
A. Hermawan, Sensors and Actuators B: Chemical, 2025 433, 137509

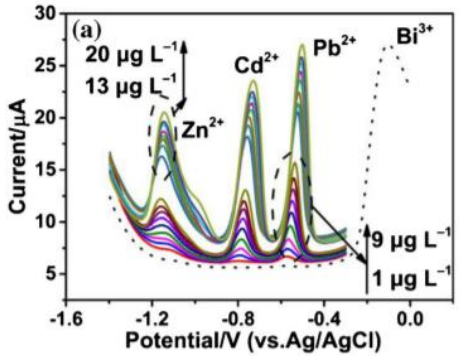
2D Materials for electrochemical sensing

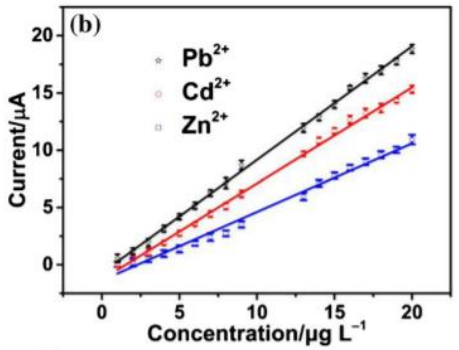


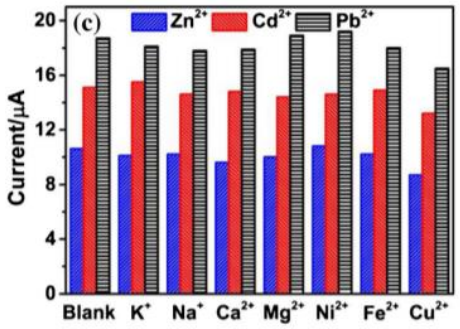


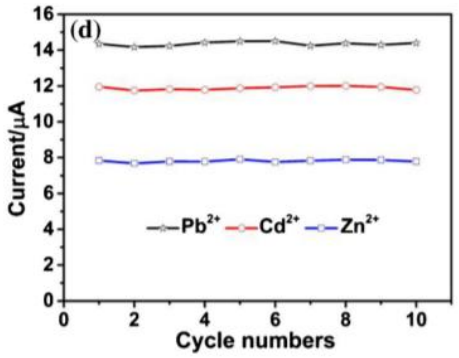


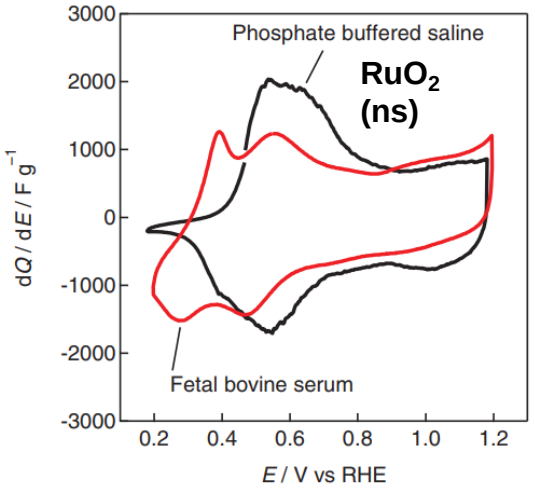






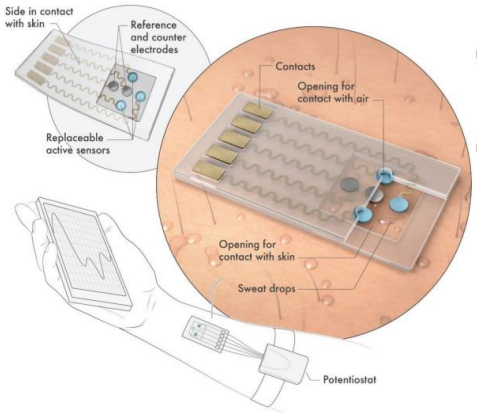


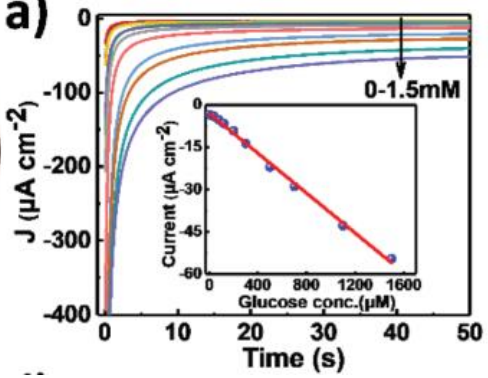




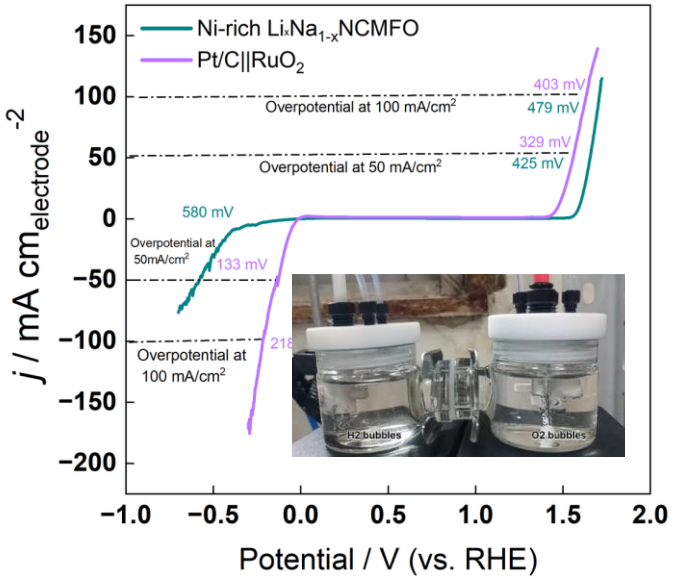
Detection of heavy metal ions in water

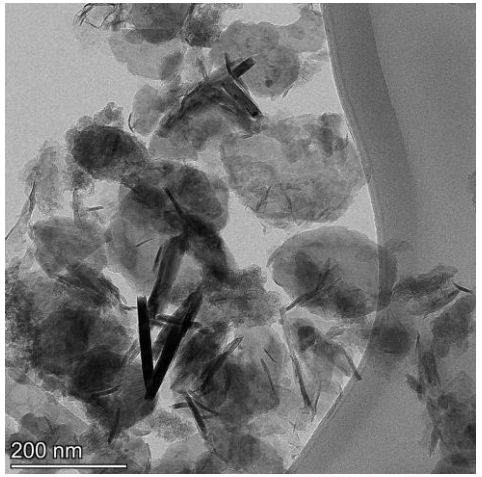
Detection of Alzheimer's and diabetes biomarkers

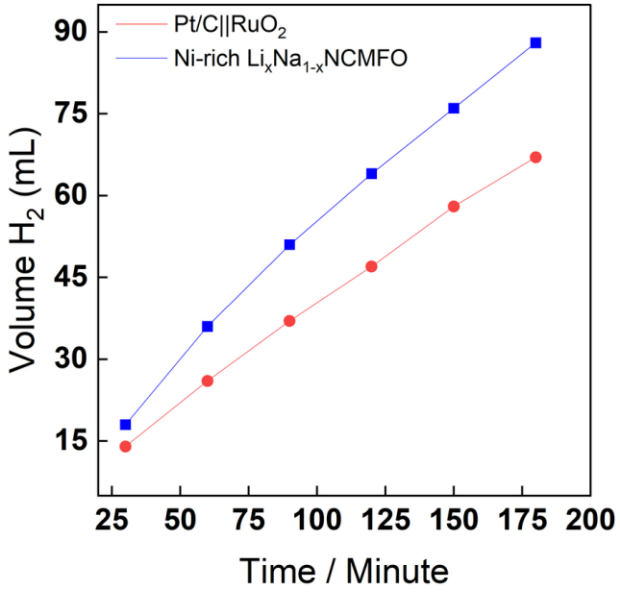


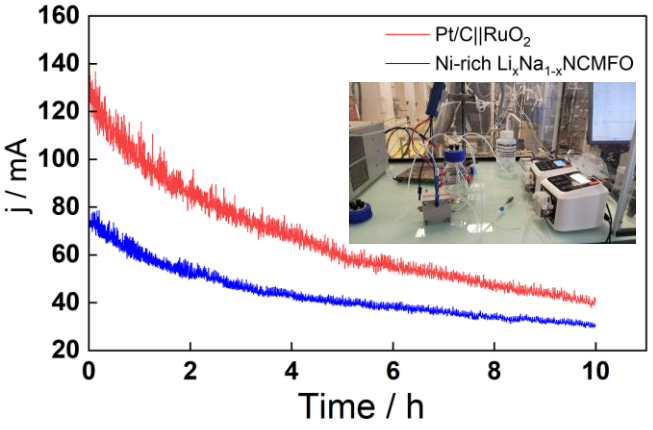


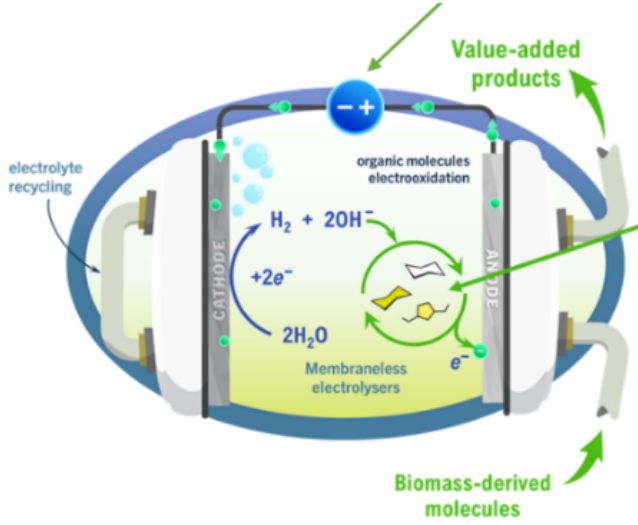
2D Materials for electrocatalysis

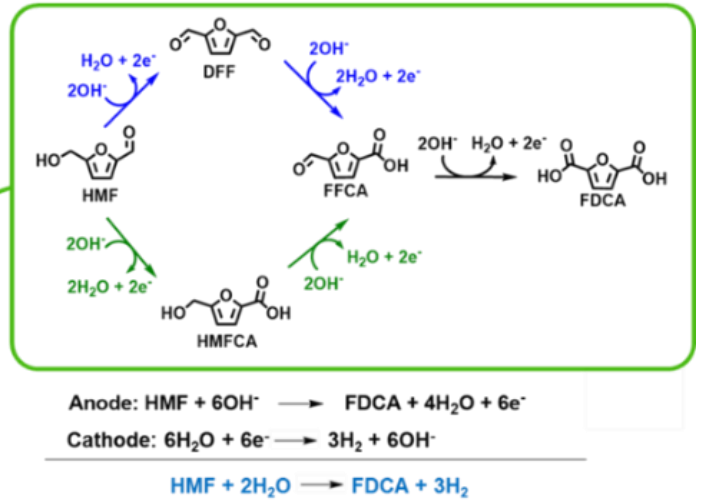












2D materials are promising electrocatalysts for producing green hydrogen from water while simultaneously converting biomass into more valuable chemicals

Nanoproducts - Inari Expo 2024

BRIN 22
BADAN RISET DAN INOVASI NASIONAL

RESEARCH CENTER FOR NANOTECHNOLOGY SYSTEMS

Silver nanoparticles (AgNPs)

Mangan Oxide Nanowire (MnO2)

F-MWCNT

Graphene Oxide

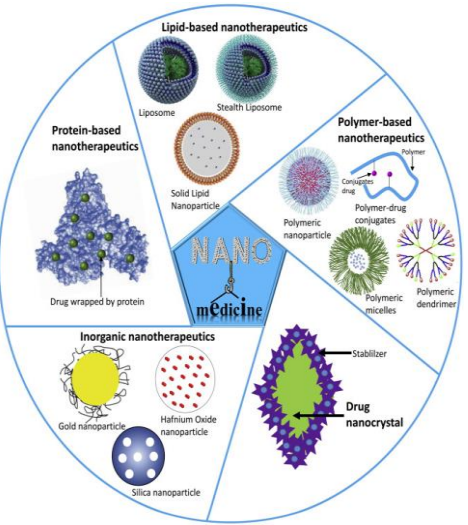
Other Studies in Indonesia ….. (1)

1

Food & Beverages

2

Pharmaceutical

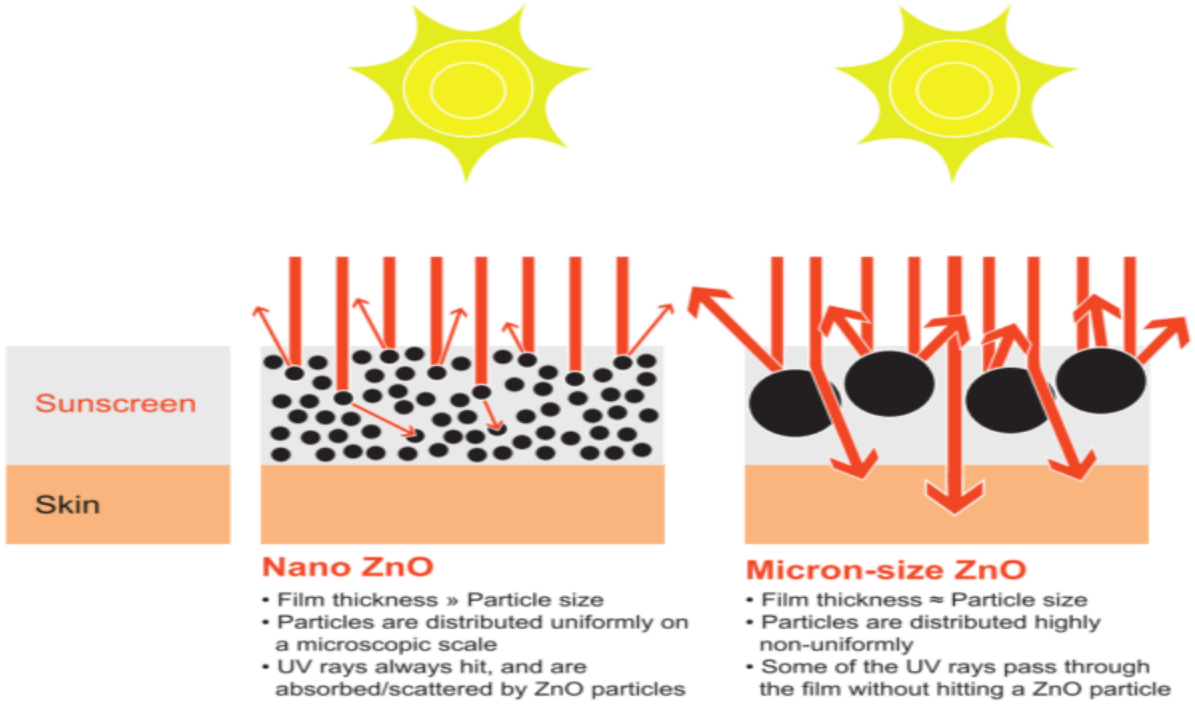


Types of Nanomaterials	Sources	Isolation Method	Utilization Form	Superior Properties	Agrifood Utilization	References	
Carbon nanoparticles and lignocellulose nanofibers	Oil palm biomass	Hydrothermal carbonization, delignification and ultra-sonication	Nanocomposite film	Increase in growth normality, potential, natality, and rate	Paddy growth regulator	Hartoyo et al. (2022)	1
Nanochisil and nanosilicon	Shrimp chitosan and graminae/ risk husk silica	Commercialized products	Liquid fertilizer	Reduction in nitrogen, phosphorus, and potassium (NPK) use, and increase in corn production, biomass, seed weight, plant height, number of leaves, wet weight, and dry weight	Fertilizer	Gumilar et al. (2017), Pertaminingsih et al. (2018), Hadiawati and Suriadi (2021)	1
Nanocellulose	Lignocellulose biomass	Chemical, enzymatic, and physical method	Individual fibers and nanocomposite	Superior adsorptive, physical, chemical, and mechanical properties	Food additives and packaging; heavy metals removal	Herawati (2019)	1
Nanochitosan	Chitosan	Ion gelation (ultrasonication coupled with chemicals)	Nanocomposite coating film	Successful production of micro-/nano-sized particles The produced nanoparticles	Herbal medicine to treat infertility	Muchtaromah et al. (2020)	2
Ash nanoparticles	Volcanic ash	Beads-milling	Powder	Improving inceptisols characteristics	Soil ameliorants	Devnita et al. (2021)	1
Protein nanofibrils	Globulin proteins from Bogor nuts	Ultracentrifugation, acid hydrolysis, and shearing treatment	Solution	Globular or fibrillar protein structures with increased functional properties	Food ingredients	Sarastani et al. (2020)	1
Nanoparticles, nanotubes, and quantum dots	Biological materials	Chemical vapor deposition, arc discharge, and laser ablation	Individual fibers or nanocomposites	Highly sensitive, real-time, and high-frequency monitoring of pollutants	Nanobiosensors	Kuswandi (2019)	2
Activated and non-activated nanocarbon	Oil palm	Carbonization, vibrational milling, and ultrasonication	Individual fibers and hydrogel	Excellent adsorptive properties (porous surface and large surface area) with enhanced properties of carbon	Heavy metals removal	Puspitasari et al. (2020); Zubaidah et al. (2021)	2
Nanoemulsion	Chitosan and nutmeg oil	High-pressure homogenizer	Emulsion	Large surface area with increased effectiveness as anti-microbial and mold-yeast	Anti-microbial coatings	Horison et al. (2019)	2
Silica nanoparticles	Commercial mesoporous silica	Stober technique	Nanocomposite hydrogels	Control slow-release agent	Antibiotics	Michael et al. (2020)	2
Microfibrilated cellulose and nanoclay	Oil palm and clay minerals	Delignification, ultrasonication and homogenizer	Nanocomposite film	Good transparency, smoothness, thermal stability, good mechanical, thermal, and gas barrier properties	Food packaging	Solikhin and Murayama (2018) ; Andini et al. (2021)	1

Other Studies in Indonesia … (2)

3 Cosmetics

No.	Trademark	Industry	Indonesian FDA Notification	Claim
1	Supreme Bionanoceramide Barrier Moisturizer	Aroma Prima Livindo	NA18230103407	Anti-Aging
2	Exclusive Cosmetics (Exco) Day Cream	Nanotech Natura Indonesia	NA18210111796	Sunscreen
3	Feeling My Skin Salicylic Acid Nanosome Acne Spot	Pesona Bintang Utama	NA18220105853	Anti-Acne
4	Systema Nano Advanced Oral Care System (Spring Fresh)	Lion Wings	NA18211400070	Dental Care
5	Systema Nano Advanced Oral Care System (Menthol Breeze)	Lion Wings	NA18131400012	Nano Calcium in Dental Care Products
6	Wrinkles And Lines Defense Biolift Nanotech Advance Lifting Serum	Mustika Ratu	NA18162000146	Anti-Aging
7	Aishaderm Premium Anti Aging-Nano Essence	Dion Farma Abadi	NA18172000176	Anti-Aging
8	Day Cream, Face Glow with Nano 3 Glow	Pesona Amaranthine Cosmetiques	NA18230106053	Anti-Aging
9	Liquid Facial Wash, Face Glow with Nano 3 Glow	Pesona Amaranthine Cosmetiques	NA18230106053	Anti-Aging
10	Refreshing Facial Toner, Face Glow with Nano 3 Glow	Pesona Amaranthine Cosmetiques	NA18231203615	Anti-Aging
11	Nigh Cream, Face Glow with Nano 3 Glow	Pesona Amaranthine Cosmetiques	NA18231901212	Anti-Aging
12	Salicylic Acid Nanosome Acne Spot	Pesona Bintang Utama	NA18220105853	Anti-Aging



BRIN
BADAN RISET
DAN INOVASI NASIONAL

Challenges in Current Indonesia's Nanotechnology Development:

- **Scalability:** Production from the lab to industry remains complex.
- **Regulation:** There are no established standards, hampering commercialization.
- **Cost:** Production is expensive, making it difficult for small businesses to access.
- **Global Competition:** Continuous innovation requires significant resources.
- **Environmental Pressure:** Demand for environmental friendly technologies requires significant investment.

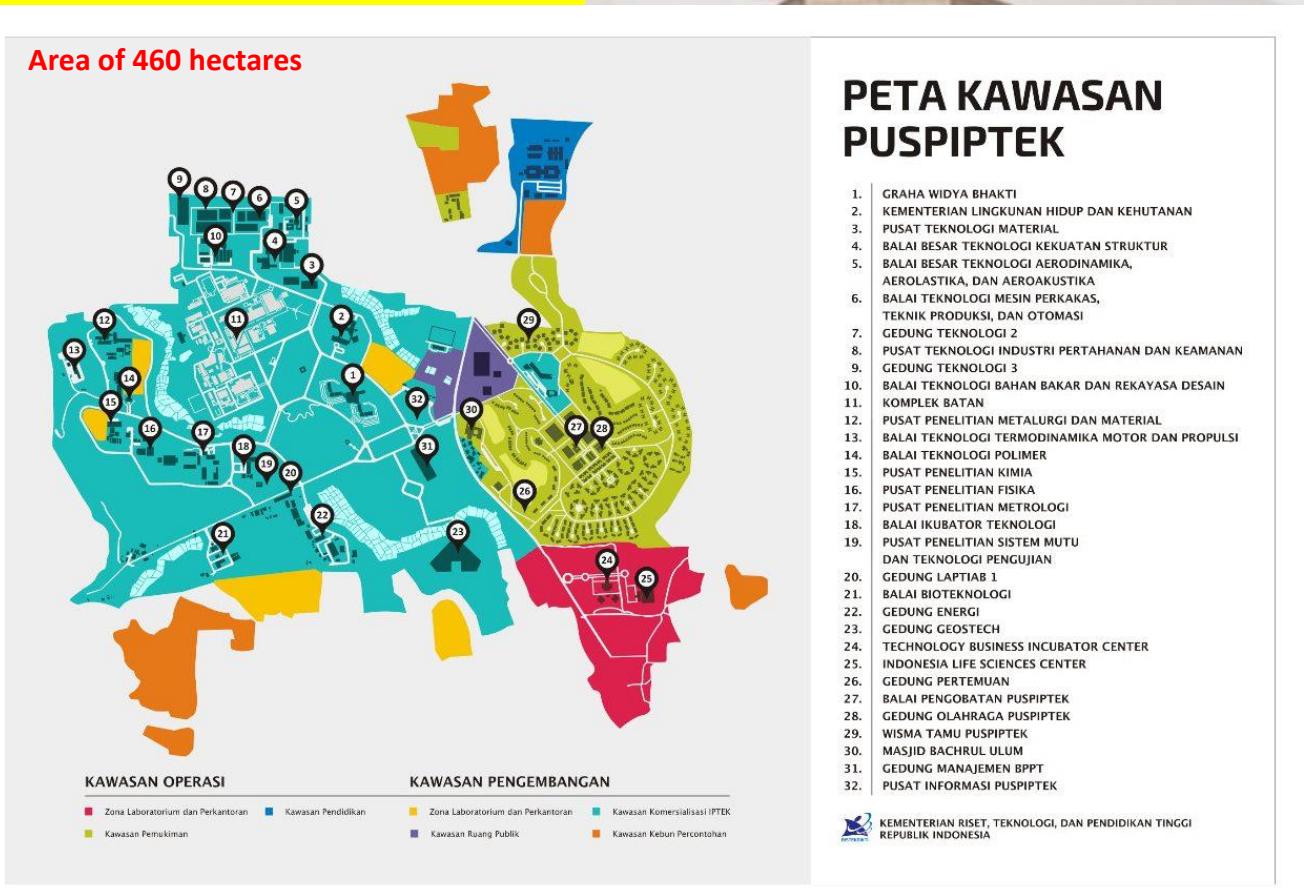
What can BRIN do ?

BRIN is to encourage research & collaboration

- Policy support, funding agency, executing agency
- Nano research and characterization facilities
- Joint research, open collaboration with industry and academia
- Accelerating nanotechnology innovation
- Indonesia's position in global competition

Laboratory of Advanced Characterization

1. Physics
2. Chemistry
3. Mining, Metallurgy, Polymer, and Materials
4. Photonics, Quantum Physics (High Performance Computer)
5. Testing Technology



Physics Lab.

Chemistry Lab.

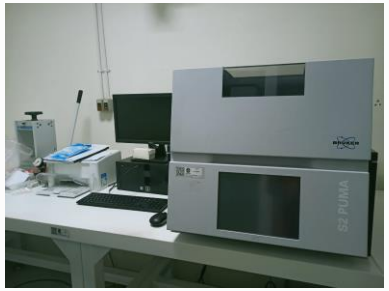
Metallurgy & Materials Lab.

Testing Technology

BRIN
BADAN RISET
DAN INOVASI NASIONAL

Raman

XRF



Particle Size Analyzer

SOX NOX Analyzer

LC MS/MS

NMR 500 MHz

NMR 700 MHz

Proximate Analysis instrument

Lab Vacuum Glove box

MicroTGA

GC-MS, LC-MS, LC-MSMS

GC Natural Gas

Viscometer

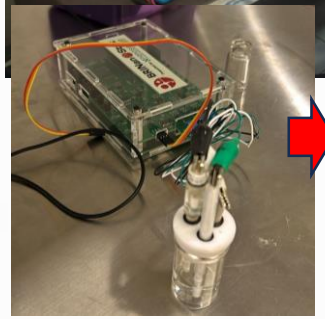
BET

XRD

FESEM-EDX

HR-TEM

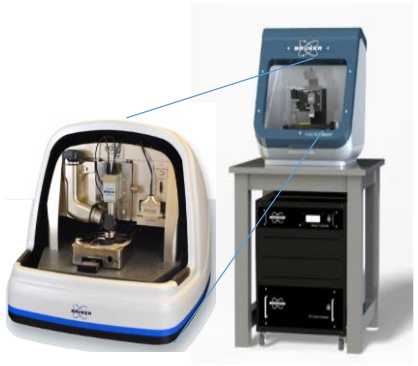
XPS



Portable BRINanostat PRSN

Device Patterning & Metallization

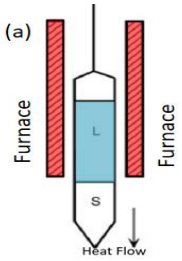
Nanoindenter

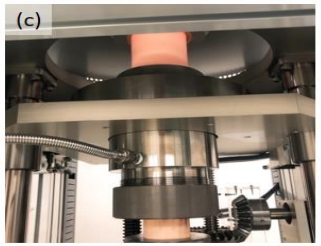


Seebeck coefficient and Electrical Conductivity (SBA) Nemesis

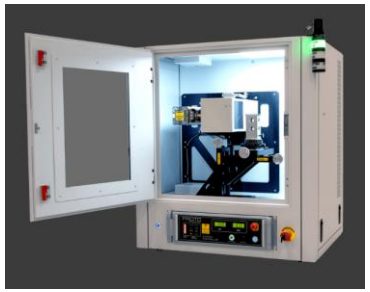
Advance Surface Area & Ultramicropore-Micropore-Mesopore size Analyzer

Single Crystal Growth Bridgman method (Crystal Growth)





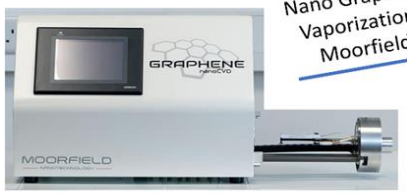
Laue back-reflection method for single crystal



wire cutting machine

Nanocarbon synthesis tools (graphene, carbon nanotubes, etc) & MXenes

1. Sistem Fabrikasi

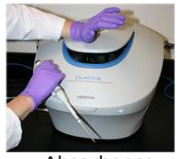


Nano Graphene Vaporization-Moorfield

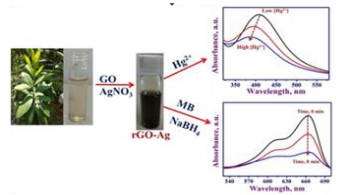
Fabrikasi material berbasis graphene dan nanocarbon

2. Sistem Pengujian

Duetta- Horiba



Absorbance Spectrophoto/fluorometer



https://doi.org/10.1002/slct.201803725

Hasil pengolahan data material Graphene Oxide

Thin film semiconductor materials fabrication tools

Sistem Preparasi Nanomaterial

Glove box 1

Coating machine in Glove Box

Sistem Fabrikasi Nanodevice

Glove box 2 with thermal evaporator

Sistem Karakterisasi Nanomaterial dan Nanodevice

Solar simulator

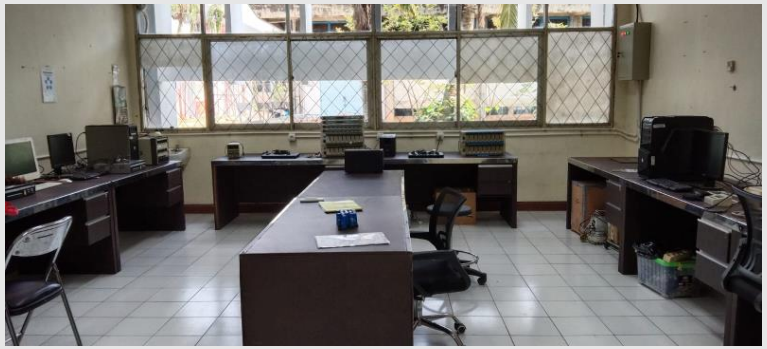
4-point probe for nanofilms

Fabrikasi dan Optimasi Nanomaterial dan Nanodevice yang efisien

Scintillator Telescope for Muography

3D Bioprinting

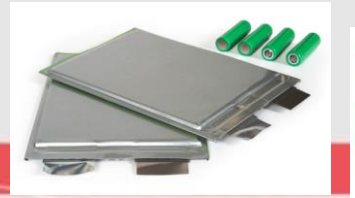
ÌNTEGRATED BATTERY LABORATORY

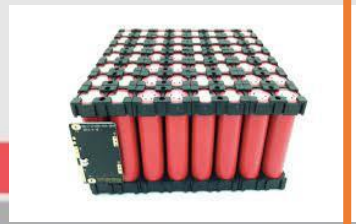


Activities Scope/Theme

- ✓Synthesis and Characterization of Active Materials for high performance Li-Ion Batteries
- ✓Local resources-based precursors and raw materials for lithium-ion batteries
- ✓Glass and polymer based solid electrolyte for all solid batteries (Solid State Battery)
- ✓Component Manufacturing (Anode and Cathode)
- ✓Battery Cell Assembly (coin/pouch/cylindrical)
- ✓Battery cell testing
- ✓Battery module/pack assembly & testing
- ✓Li-Ion battery Material Recycling
- ✓Beyond battery Lithium

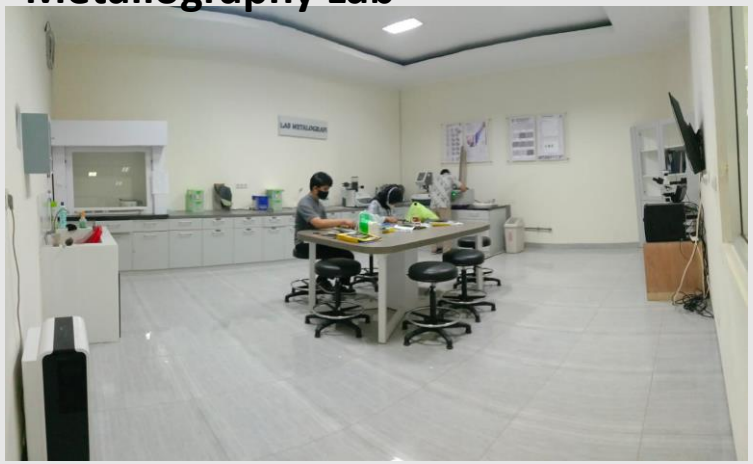
Output





METALLURGY - FACILITIES

Metallography Lab



Flame Spray Coating

High Velocity Oxy Fuel (HVOF)

Chemical Vapor Deposition

Milling

Spark Plasma Sintering

High Temp Oxidation

High Temp. Errosion Test

Creep and Pulling Test, etc.

High Temp. Corrosion Test

Integrated Mineral Laboratory - Lampung

- Mineral Characterization Lab.
- Hydroelectrometallurgy Lab. & Pilot Plant
- Pyrometallurgy Lab. & Pilot Plant
- Biometallurgy Lab.
- Non-Metal Processing Lab. & Pilot Plant
- Comminution & Beneficiation Lab.
- Heat Treatment Lab.

Iskandar Zulkarnain's Sains Area

Integrated mining Laboratory

Pilot plant mining laboratory

BRIN

BADAN RISET
DAN INOVASI NASIONAL

THANK YOU