



## CONSORTIUM ON MATERIAL SCIENCE DEVELOPMENT

Comprehensive Programs, Based on Memorandum of Agreement

Version 1.0 – 30 December 2023 - Full Version

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In its pursuit of advancing the field of Material Science, the Consortium on Material Science Development is committed to a long-term strategic vision that resonates deeply with Indonesia's unique context. Our Comprehensive Programs are meticulously designed to address a wide range of critical areas, from the untapped potential of Indonesia's vast natural and mineral resources to cutting-edge research and development, impactful educational initiatives, industry collaboration, and advocacy for beneficial policies. These programs form the cornerstone of our efforts, representing a holistic approach that not only fosters innovation and enhances educational standards but also creates significant societal impacts. This commitment is particularly exemplified in our focus on responsible mapping and utilizing Indonesia's rich mineral resources, ensuring sustainable development. The following ten key areas illustrate our comprehensive roadmap for transforming Material Science research, application, and education, tailored to Indonesia's needs and its standing on the global stage.

### 1. Research & Development Initiatives:<sup>1</sup>

- a. Establish state-of-the-art laboratories focused on Material Science research, enabling advancements in areas like nanotechnology, biomaterials, sustainable materials, and net zero emission solutions derived from Indonesia's natural resources.
- b. Collaborative research projects on optimizing materials for specific applications like magnetics, electronics, catalysts, energy, medical, construction, sensor technology (including electrochemistry sensor tools), and environmental treatment applications. This focus will involve developing materials with specific, enhanced properties for various applications, including environmental monitoring and remediation.

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<sup>1</sup> These programs contribute to multiple SDGs such as Goal 9 (Industry, Innovation, and Infrastructure) and Goal 12 (Responsible Consumption and Production)



- c. Develop new instruments and equipment for material characterization, processing, and analysis, including high-resolution microscopes, spectroscopy tools, computational modeling systems, advanced fabrication facilities, and specialized tools for sensor technology.
- d. Emphasize interdisciplinary research integration by combining Material Science with fields such as environmental science, computer science for AI and data analysis, and social sciences. This approach aims to address complex real-world problems through a holistic perspective, leveraging cross-disciplinary insights and methodologies to enhance the scope and impact of Material Science research.
- e. Implement a robust framework for risk assessment and management in new material development. This includes systematically identifying potential risks associated with material innovations and developing strategies to manage and mitigate these risks effectively. This approach ensures that new materials are not only innovative but also safe and sustainable for various applications.

## 2. Educational & Training Programs:

- a. Organize regular workshops, seminars, conferences, and collaborative educational programs on the latest advancements in Material Science, including student workshops and information exchange initiatives.
- b. Develop specialized training programs **emphasizing sustainable material processing and eco-innovation**<sup>2</sup> to equip professionals with skills in material processing, characterization, application, and computations.
- c. Initiate tailored educational initiatives to foster interdisciplinary research and collaboration across various fields of science, thereby enhancing the scope and impact of Material Science research.
- d. Launch joint university courses or degree programs focusing on Material Science, incorporating a standardized curriculum to ensure consistency and excellence across institutions. This includes establishing accreditation standards and educational benchmarks for Material Science education, aligning various universities under a unified framework of academic quality and relevance.

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<sup>2</sup> This program contribute to SDG Goal 4 (Quality Education) and Goal 12.



### 3. Industry Collaboration:

- a. Partner with local industries to understand their material needs and develop tailored solutions.
- b. Facilitate technology transfer from academic research to industrial applications,<sup>3</sup> including researcher exchange, joint-research projects, guest lectures, and student co-supervision initiatives.
- c. Promote the establishment of startup companies focusing on innovative material solutions **that align with SDG Goal 7 (Affordable and Clean Energy) and Goal 13 (Climate Action).**

### 4. Resource Mapping:

- a. Undertake extensive studies to map out and categorize Indonesia's vast natural resources from a Material Science perspective, including a special emphasis on the 47 critical mineral resources recently identified in the September 2023 Minister of Energy and Mineral Resources Regulation. This study will focus on the potential exploitation and utilization of these critical minerals in various Material Science applications.
- b. Identify potential materials that can be sustainably harvested and used, and explore the opportunities for developing materials from marine sources such as algae, marine minerals, and biocomposites. **This also emphasizes the importance of biodiversity<sup>4</sup> and the need for conservation of marine resources<sup>5</sup>, where applicable.**

### 5. Sustainability Initiatives:<sup>6</sup>

- a. Research on sustainable and eco-friendly materials, with a focus on reducing waste and promoting recycling.
- b. Promote the use of bio-based materials derived from plants, minerals, and other natural resources available in Indonesia.
- c. Initiate specific research and development projects for materials contributing to climate change mitigation and adaptation. This includes exploring materials that support net zero emission goals and enhance climate resilience, addressing the urgent need for sustainable solutions in response to global climate challenges.

<sup>3</sup> Depends on government policies and the roles of scientific societies.

<sup>4</sup> SDG Goal 15: Life on Land

<sup>5</sup> SDG Goal 14: Life Below Water

<sup>6</sup> These programs are well-aligned with SDGs, specifically Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action).



- d. Integrate a strong focus on the circular economy in developing and utilizing materials. This involves researching and promoting the design of materials that are easily recyclable or reusable, thereby fostering a more sustainable, circular approach to resource management and minimizing environmental impact.

#### 6. International Collaboration:

- a. Form partnerships with international Material Science organizations and research institutes.
- b. Exchange programs for students, researchers, and professionals to foster global collaboration and share knowledge, **and enhance existing programs to include sustainability-focused projects that advance SDG Goal 17 (Partnerships for the Goals).**

#### 7. Outreach & Community Engagement:

- a. Organize community engagement events to educate the public about the importance of Material Science and its potential benefits.
- b. Collaborate with schools and scientific networks, including ISMS & MIPAnet, to introduce **sustainability concepts through** Material Science education to younger students, fostering early interest **in Material Science and SDGs.**<sup>7</sup>
- c. Strengthen scientific societies by facilitating their involvement in outreach programs and educational initiatives. These societies can play a pivotal role in bridging the gap between research and public awareness, especially in showcasing how Material Science contributes to understanding and utilizing natural resources sustainably. Additionally, they can offer expert guidance and resources to schools and community programs, enhancing the overall impact of educational efforts.
- d. Integrate ethical considerations and social responsibility into all outreach and community engagement activities. This includes promoting the ethical sourcing of materials, understanding the societal impact of Material Science developments, and fostering responsible innovation. By emphasizing these values, the consortium aims to ensure that advancements in Material Science are aligned with ethical standards and contribute positively to society.

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<sup>7</sup> This program contributes to SDG Goal 4 (Quality Education).



## 8. Innovation Hubs & Incubators:

- a. Establish innovation hubs where researchers, students, and entrepreneurs can come together to brainstorm and prototype new ideas, **with a specific focus on sustainable material solutions and technologies**.<sup>8</sup>
- b. Support startups and innovators with funding, mentorship, and resources to bring their Material Science innovations to the market.

## 9. Publications & Digital Platforms:

- a. Launch a dedicated journal<sup>9</sup> or magazine highlighting the latest research and advancements in Material Science within the consortium **and including a section on sustainable Material Science practices**.<sup>10</sup>
- b. Create an online platform or consortium website where members can share their research, collaborate on projects, and access a database of resources.<sup>11</sup>
- c. Develop a mobile application to facilitate citizen science initiatives, enabling everyday citizens such as farmers and miners to contribute data and observations relevant to Material Science. This app can gather information about local environmental conditions, resource availability, or material usage, which can be valuable for ongoing research and sustainability studies. By engaging the community in this manner, the application can enhance public understanding and involvement in Material Science while providing researchers with grassroots-level data that might otherwise be inaccessible.

## 10. Policy Advocacy:

- a. Engage with policymakers to advocate for favorable policies and regulations that promote Material Science research and its applications.
- b. Provide expert consultation to the government on topics related to Material Science and its potential impact on the economy and society.<sup>12</sup>

<sup>8</sup> This program contribute to SDG Goal 7 (Affordable and Clean Energy) and Goal 9 (Industry, Innovation and Infrastructure).

<sup>9</sup> Journal of Computational Molecular and Material Design. Another proposed publication is Journal on Natural Materials and Computations.

<sup>10</sup> .. **aligning with SDG Goal 12 (Responsible Consumption and Production)**.

<sup>11</sup> Database of researchers, database of instruments and equipment, database of industries

<sup>12</sup> The inaugural action for this agenda item involves the CMSD Presidium authoring a letter to the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek), the Ministry of Energy and Mineral Resources (Kementerian ESDM), the Coordinating Ministry for Maritime & Investment Affairs (Kemenkomarves), National Research and Innovation Agency (BRIN), funding agencies (such as LPDP and the





- c. Advocate for increased funding and financial support for Material Science research and development, emphasizing the promotion of national and international collaborations in the field of Material Science. This includes lobbying for government grants, subsidies, and tax incentives for research institutions and private companies engaged in Material Science. Additionally, promote the establishment of public-private partnerships and encourage foreign investment in Material Science initiatives, aiming to bolster the field's growth and innovation.
- d. Emphasize the importance of intellectual property (IP) management and commercialization strategies. Guide research institutions and startups in protecting their innovations through appropriate IP rights and assist in the effective commercialization of these advancements. This focus will ensure that breakthroughs in Material Science are not only protected but also successfully transitioned from research to market, contributing to the economic vitality of the Material Science sector.

Implementation of some or all of these programs can foster collaboration, drive innovation, and maximize the value derived from Indonesia's rich natural resources through advancements in Material Science.

## **Material Science Narrative and Development Task Force**

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Indonesian Science Fund), Mind-Id, and the Indonesian Mineral and Material Research Institute (IMMRI). The purpose of this letter is to suggest the establishment of open grant programs. These grants would be aimed at advancing research and development in the enhancement of Indonesia's critical mineral resources and the broader natural resources sector. The proposed grants should be accessible not only to consortium members but also to universities and other institutions across Indonesia, fostering a wider scope of innovation and development in the field.



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