International Journal of Research and Applied Technology

3(2)(2023) 359-365
Journal homepage: https://ojs.unikom.ac.id/index.php/injuratech

# Advancing Material Research in Indonesia: Insights from Computational Bibliometric Analysis

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**Abstract.** Material research in Indonesia has become a critical area of focus, driving advancements across various industries, including energy, electronics, and environmental sustainability. This study employs computational bibliometric analysis to assess the trends, contributions, and evolution of material research in Indonesia over the past two decades. By analyzing publication outputs, citation patterns, and key subject areas, this research offers a comprehensive overview of the state of material science in the country. The findings reveal a steady increase in research activity, with notable contributions from fields such as materials science, engineering, and environmental science. The paper also highlights key research themes and identifies opportunities for further growth, emphasizing the need for enhanced collaboration among academic, industrial, and governmental sectors to accelerate innovation in materials research.

**Keywords:** Bibliometric Analysis, Computation, Material Research.

## 1. Introduction

Material research plays a pivotal role in the development of technologies that drive innovation and address global challenges such as energy sustainability, climate change, and resource efficiency. In Indonesia, material science has become an area of increasing interest, particularly in sectors like energy, manufacturing, electronics, and environmental management. The country's growing research output in this field is reflective of its commitment to fostering technological advancements that can support industrial growth and environmental sustainability [1].

To understand the dynamics of material research in Indonesia, a systematic approach is needed to analyze its progress, emerging trends, and areas of strength. Bibliometric analysis,

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which uses computational methods to evaluate publication patterns, citations, and collaboration networks, offers a valuable tool for mapping the development of research fields. Previous studies relating to bibliometrics is shown in Table 1. This study employs bibliometric techniques to explore the landscape of material research in Indonesia, focusing on trends over the last two decades.

**Table 1.** Previous studies relating to bibliometric analysis

| No | Title | Ref. |
|---|---|---|
| 1 | A bibliometric analysis of COVID-19 research using VOSviewer | [2] |
| 2 | The latest report on the advantages and disadvantages of pure biodiesel (B100) on engine performance: Literature review and bibliometric analysis | [3] |
| 3 | A bibliometric analysis of management bioenergy research using vosviewer application | [4] |
| 4 | Research mapping in the use of technology for fake news detection: Bibliometric analysis from 2011 to 2021 | [5] |
| 5 | Management information systems: bibliometric analysis and its effect on decision making | [6] |
| 6 | Sustainable Production-inventory model with multi-material, quality degradation, and probabilistic demand: From bibliometric analysis to a robust model | [7] |
| 7 | Phytochemical profile and biological activities of ethylacetate extract of peanut (Arachis hypogaea L.) stems: In-vitro and in-silico studies with bibliometric analysis | [8] |
| 8 | Biomass-based supercapacitors electrodes for electrical energy storage systems activated using chemical activation method: A literature review and bibliometric analysis | [9] |
| 9 | Antiangiogenesis activity of Indonesian local black garlic (Allium Sativum 'Solo): Experiments and bibliometric analysis | [10] |
| 10 | Characteristics of tamarind seed biochar at different pyrolysis temperatures as waste management strategy: Experiments and bibliometric analysis | [11] |

By investigating the volume of publications, document types, and subject areas, this study aims to provide insights into the trajectory of material science research in Indonesia. The

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results will highlight key contributors, research themes, and the influence of global scientific trends on the country's research priorities. This analysis aims to guide future research efforts and inform strategies to enhance collaboration between academic, industry, and government sectors in driving forward material science innovation.

## 2. Method

This study employed a computational bibliometric analysis approach to investigate the advancements in particle technology research in Indonesia. We used Scopus database for this matter. The method consisted of the following steps: Relevant scholarly publications were retrieved from major academic databases in the scopus database. Search terms were tailored to include "particle technology" and related keywords country with geographic filters set to Indonesia-based research (see Figure 1).

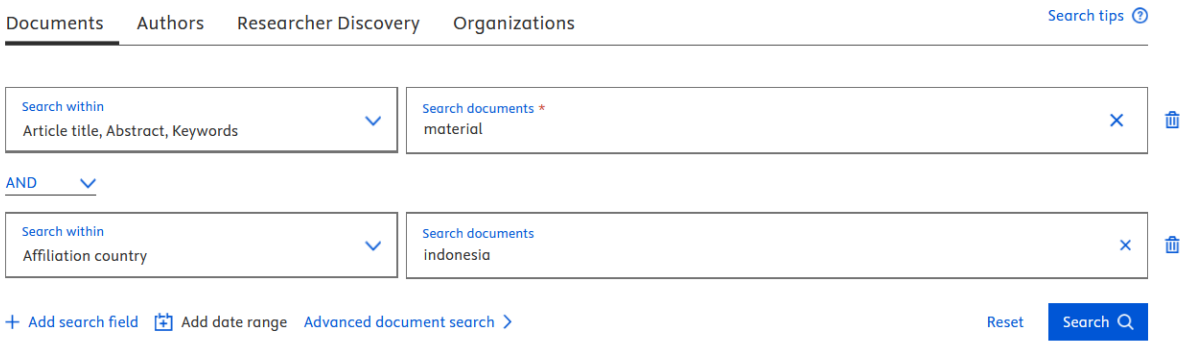


**Figure 1.** Searching method in Scopus.

Several data were taken, including:

(i) Publication Trends: The number of publications over time was analyzed to identify growth patterns.

(ii) Authorship and Collaboration Networks: Co-authorship networks were mapped to assess collaboration patterns among researchers and institutions.

(iii) Keyword Co-occurrence Analysis: Keywords were analyzed to determine prevalent and emerging research topics.

## 3. Results and Discussion

Figure 2 shows publication trend. The publication trend in material research in Indonesia shows a significant increase over the past two decades, as indicated by the data analysis. Initially, research output remained relatively low, with only a modest number of publications being produced each year. However, starting around the mid-2010s, there was a sharp and consistent rise in the number of publications, peaking in recent years. This upward trend can be attributed to several factors. One possible reason for this increase is the growing recognition of the importance of materials science in addressing global challenges, such as sustainability, renewable energy, and technological innovation. As Indonesia seeks to enhance its industrial and technological capabilities, material research has gained importance in various sectors,

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including energy, environmental management, electronics, and manufacturing. Another contributing factor is the improved research infrastructure, funding opportunities, and greater academic collaboration within Indonesia and internationally. These developments have likely provided researchers with the necessary resources and platforms to produce more high-quality research. Additionally, there may have been a shift in focus from theoretical studies to applied research, making material science a more attractive area of study and publication. Furthermore, as Indonesia's participation in global scientific communities grows, researchers are more likely to collaborate with international institutions, contributing to the increase in publications. These collaborations foster knowledge exchange and increase the visibility of Indonesian research on the global stage. Overall, the publication trend reflects both the maturation of material research in Indonesia and the country's response to emerging scientific, industrial, and environmental needs. The sharp increase in publications over the last few years indicates a flourishing field, with growing international recognition and continued potential for innovation. This is also shown in Figures 3 and 4, relating to types of publication and collaborating countries, involved, respectively.

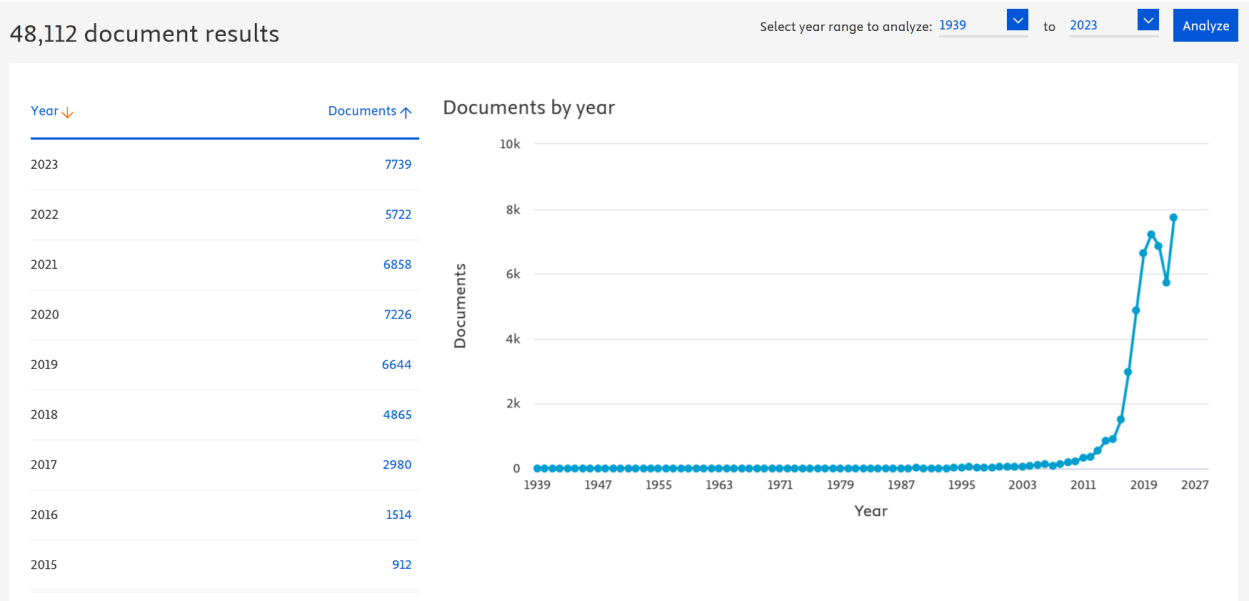


**Figure 2.** Publication trend.

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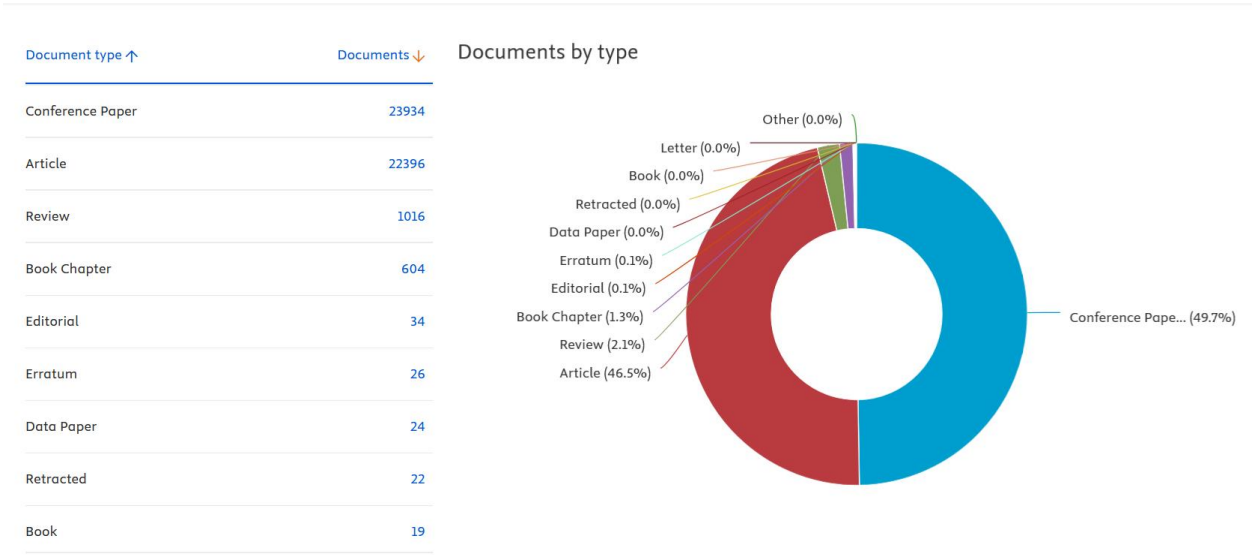
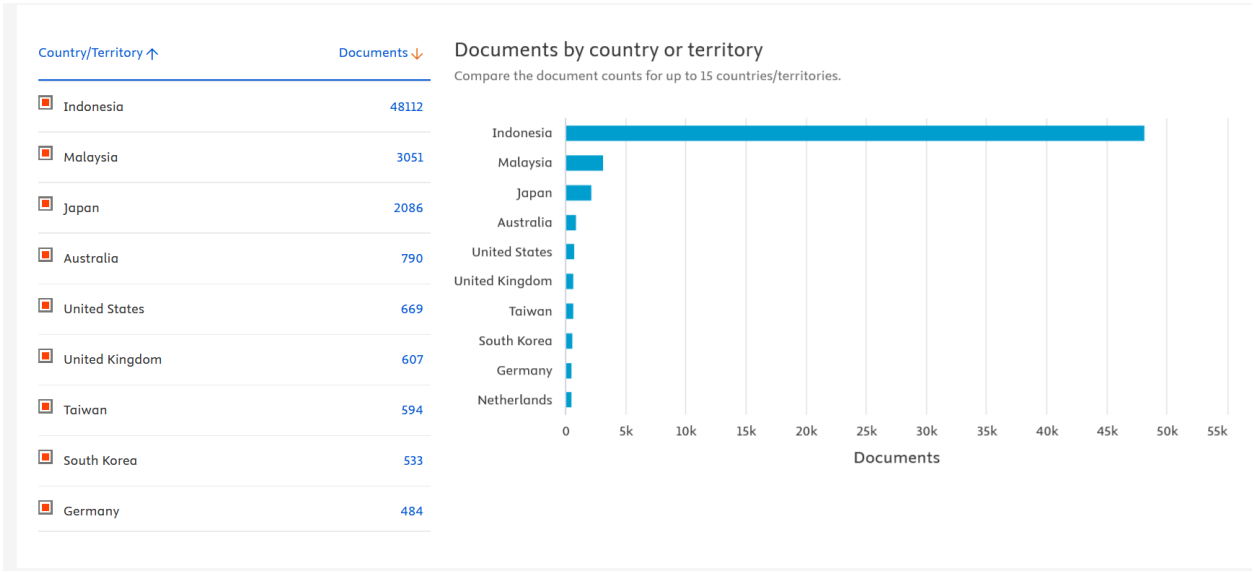


| Document type | Documents |
|---|---|
| Conference Paper | 23934 |
| Article | 22396 |
| Review | 1016 |
| Book Chapter | 604 |
| Editorial | 34 |
| Erratum | 26 |
| Data Paper | 24 |
| Retracted | 22 |
| Book | 19 |



**Figure 3.** Types of publication



| Country/Territory | Documents |
|---|---|
| Indonesia | 48112 |
| Malaysia | 3051 |
| Japan | 2086 |
| Australia | 790 |
| United States | 669 |
| United Kingdom | 607 |
| Taiwan | 594 |
| South Korea | 533 |
| Germany | 484 |



**Figure 4.** Countries involved in research.

The results of this bibliometric analysis highlight the dynamic growth of material research in Indonesia, reflecting the increasing importance of materials science in addressing both domestic and global challenges. The steady rise in publications over the last two decades indicates that Indonesia has made significant strides in expanding its research output, with the most prominent contributions coming from the fields of materials science, engineering, and environmental science. This growth corresponds with the global shift toward sustainable technologies, clean energy solutions, and innovations in manufacturing processes. Indonesia's research agenda aligns well with these global trends, emphasizing the country's efforts to contribute to the advancement of materials for energy storage, environmental protection, and technological innovation.

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The dominance of certain subject areas, such as materials science and engineering, underscores the emphasis on practical applications and the development of new materials for various industries, including energy, electronics, and construction. This focus is critical as the country seeks to address challenges like climate change, resource depletion, and energy sustainability. The increasing number of publications in environmental science also highlights the growing awareness and need for materials that contribute to sustainable development, particularly in waste management, renewable energy, and pollution control.

While the progress in material research is commendable, there are areas where further development and attention are needed. For instance, despite the significant rise in research output, the majority of publications remain in the form of conference papers. This suggests that while there is a vibrant research community, further efforts are needed to enhance the quality and depth of published articles in peer-reviewed journals. A greater focus on long-term, impactful research and collaboration with international researchers could help elevate Indonesia's material science contributions on a global scale.

Moreover, the interdisciplinary nature of materials research suggests that cross-sector collaborations will be essential to drive the innovation needed to address complex challenges. Strengthening connections between academia, industry, and government could help bridge the gap between scientific advancements and practical applications, ensuring that research outcomes lead to tangible benefits for the country and the broader global community. Collaboration can also foster a more holistic approach to material design, emphasizing sustainability and environmental considerations.

In conclusion, while Indonesia has made notable progress in material research, further development is needed to maximize its potential. Expanding international collaborations, increasing journal publications, and focusing on applied research will be key to driving the country's material science agenda forward. With continued investment and strategic partnerships, Indonesia can further establish itself as a leader in material research, contributing to global technological advancements and sustainable solutions.

## 4. Conclusion

This study provides a comprehensive bibliometric analysis of material research in Indonesia, highlighting the significant growth and diversification of the field over the past two decades. The findings demonstrate a steady increase in research output, with notable contributions from areas such as materials science, engineering, and environmental science, aligning with global trends in sustainability and technology development. The rising volume of publications emphasizes the growing importance of material research in addressing national and global challenges. The analysis also reveals key research themes, including advancements in energy materials and eco-friendly technologies, which reflect Indonesia's commitment to environmental sustainability. To continue fostering innovation, Indonesia must strengthen interdisciplinary collaborations and partnerships between academia, industry, and government. By enhancing research infrastructure and aligning efforts with global research priorities, Indonesia can further establish itself as a leader in material science research and development.

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