Update Article

Data extraction of nano silica as a potential filler in nanocomposites from rice husk ash with ballmill and coprecipitation methods

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A B S T R A C T

This article consists of data from the extraction of nano silica from rice husk ash (RHA) by ball mill and coprecipitation methods. RHA is an agricultural waste that is widely found in Indonesia. The extracted RHA can be used as a filler in nanocomposites. Calcining RHA did silica extraction from rice husk ash at 500 °C for 5 h. After calcining RHA in the Ball Mill for 10 h with a rotation of 250 rpm. Furthermore, RHA was mixed with 5 M HCl in a ratio of 1:4, stirred, and heated with a Magnetic Stirrer at 70 °C for 4 h at a speed of 400 rpm. Then mixed again with NH₄OH M in a ratio of 1:4, stirred, and heated with a Magnetic Stirrer at a temperature of 70 °C for 4 h at a speed of 400 rpm. The resulting RHA was further characterized by Scanning Electron Microscope (SEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). The data shows that nano silica from RHA is optimal and can be used as a filler in nanocomposites.

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Specifications Table

| Subject: | Materials Science |
|---------|------------------|
| Specific subject area: | Material Characterization |
| Type of data: | Table |
| How the data were acquired: | The functional group changes that occurred in the compounds were analyzed by FTIR Agilent Cary 630. Crystal structure and size were characterized by XRD y type Shimadzu 6100 (40 kV, 30 mA) with a wavelength of Cu-Kα = 1.5405 = 0.15406 nm, at a rate of 2°/min at an angle range of 2θ = 5°–70°. The surface morphology of the samples was characterized by SEM |
| Data format: | Raw |
| Description of data collection: | The functional group changes that occurred in the compounds, Crystal structure, size and the surface morphology of the samples was characterized by FTIR, XRD and SEM |
| Data source location: | • Institution: Universitas Negeri Medan  
• City/Region: Medan, Sumatera Utara  
• Country: Indonesia |
| Data accessibility: | Reserved DOI: Mendeley Data, V1, DOI: 10.17632/3bkssdznyg.2  
https://data.mendeley.com/datasets/3bkssdznyg |
| Related research article: | Ginting, E. M., Wirjosentono, B., Bukit, N., & Agusnar, H. (2014). Preparation and characterization of rice husk ash as filler material in thermoplastic composites. Chem. Mater. Res., 6(7), 14-24  
https://iiste.org/Journals/index.php/CMR/article/view/14125 |

Value of the Data

• This data is useful because the data shows the silica potential of rice husk ash.
• This data is useful for researchers who want to find alternatives to silica which usually comes from its precursors.
• This data is useful for researchers who want to research about the use of fillers in nanocomposites.
• This data can be reused for further insight and/or experimental development by modifying the method used and using this silica data as a filler in nanocomposites.
• This data can be used by researchers to find sources of silica from other agricultural wastes.
• This data can be used by researchers to determine the potential of silica derived from rice husk ash as a substitute for silica in other materials.

1. Objective

The reason and context behind this data set are to find the potential of silica derived from rice husk ash. In addition, the context of making this data set was made to determine the optimum method of silica preparation to obtain the optimal silica yield to be applied as a nanocomposite filler.

2. Data Description

Indonesia is one of the largest rice-producing countries in the world. So, there is a massive waste of rice husks (RH). It is still widely used as a fuel for burning. About 20% of ash can be obtained from RH combustion. Many researchers report that rice husk ash (RHA) contains about 87–98% silica (SiO₂). The rest is metal impurities such as K₂O, Al₂O₃, CaO, MgO, Na₂O, Fe₂O₃ with the percentage of each compound less than 1% [1–3]. This article consists of data from the
Fig. 1. FTIR of RHA: a. ballmill and b. coprecipitation.

Table 1
Shows the functional groups of RHA ballmill and coprecipitation.

| Wavenumber (cm$^{-1}$) | RHA Ballmill | RHA Coprecipitation | Functional Group                                           |
|------------------------|--------------|----------------------|-----------------------------------------------------------|
| 601.89                 | 620.59       | Bending vibration of Si-O |
| 788.05                 | 788.14       | Symmetric and symmetric stretching mode at SiO-Si         |
| 1063.26                | 1063.45      | Si-O-Si stretching modes                                    |

extraction of nano silica from rice husk ash (RHA) by ball mill and coprecipitation methods. RHA is an agricultural waste that is widely found in Indonesia. The extracted RHA can be used as a filler in nanocomposites [4].

2.1. FTIR Characterization

The FTIR used is the Agilent Cary 630 FTIR. This flexible benchtop FTIR instrument that offers high performance and exceptional ease of use in an ultra-compact design. Fig. 1 shows the FTIR data of RHA ballmill and RHA coprecipitation. Table 1 shows the functional groups of RHA ballmill and coprecipitation.

2.2. SEM Characterization

SEM characterization was carried out using the SEM TM3030 model. Hitachi High-Tech has provided a “5 kV mode” that allows for sharper observations of the surface structure of the finest samples, which cannot be observed at high accelerating voltages (Fig. 2).

2.3. XRD Characterization

XRD characterization is useful for obtaining diffraction patterns and crystal structures. The XRD used is the Shimadzu 6100 type (40 kV, 30 mA) with a wavelength of Cu-Kα1 = 1.5405 = 0.15406 nm, with a rate of 2°/min at an angle range of 2θ = 5 ° 70°. Fig. 3 shows the XRD data of RHA ballmill and RHA coprecipitation [5]. Meanwhile, the XRD data of RHA ballmill and coprecipitation are shown in Table 2.
Fig. 2. SEM of RHA: a. ballmill and b. coprecipitation.

Fig. 3. XRD of RHA: a. ballmill and b. coprecipitation.

Table 2
The XRD data of RHA ballmill and coprecipitation.

| XRD Data       | RHA Ballmill       | RHA Coprecipitation |
|----------------|--------------------|---------------------|
| Crystal system | Tetragonal         | Monoclinic          |
| Space group    | P 4 1 2 1 2 (92)   | C 1 c 1 (9)         |
| Unit cell      | a = 499,600 Å, c = 701,600 Å | a = 1,852,400 Å, c = 2,381,000 Å |
| Density        | 227,900 g/cm³      | 225,600 g/cm³      |
| 2 theta angle  | 2182               | 2179                |
| Maximum d_{hkl} | 101                | 112                 |
| Intensity I/I₀ | 1000               | 1000                |
| Lattice distance d (Å) | 40,696          | 43,278              |
| 2 theta angle  | 1094               | 10,88               |
| Maximum d_{hkl} | 200                | 40-4                |
| Intensity I/I₀ | 125                | 825                 |
| Lattice distance d (Å) | 24,980           | 40,998              |
| 2 theta angle  | 2060               | 2071                |
| Maximum d_{hkl} | 012                | 204                 |
| Intensity I/I₀ | 92                 | 564                 |
| Lattice distance d (Å) | 28,709           | 43,127              |
| 2 theta angle  | 3607               | 3608                |
| Maximum d_{hkl} | 111                | -114                |
| Intensity I/I₀ | 75                 | 270                 |
| Lattice distance d (Å) | 31,553           | 38,280              |
3. Experimental Design, Material and Methods

3.1. Materials

This research was carried out in the laboratory of Universitas Negeri Medan, Universitas Sumatera Utara. The materials used are Rice husk ash (RHA), 5M HCl, NH₄OH Merck Pro Analis, Aquades.

3.2. Methods

Raw RHA obtained from rice processing was calcined at a temperature of 500 °C for 5 h and the milling for 10 h with a rotation of 250 rpm. Furthermore, RHA was mixed with 5 M HCl in a ratio of 1:4, stirred, and heated with a magnetic stirrer at 70 °C for 4 h at a speed of 400 rpm. RHA, which has been mixed with 5M HCL, is filtered using filter paper, then remixed with NH4OH in a ratio of 1:4, stirred, and heated with a Magnetic Stirrer at a temperature of 70 °C for 4 h at a speed of 400 rpm. Then filtered and washed with distilled water to produce a neutral pH and dried in an oven at 150 °C for 5 h. The resulting RHA was further charac-
characterized by Scanning Electron Microscope (SEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). The preparation scheme for extracting silica from RHA is shown in Fig. 4.

**Ethics Statements**

The research does not involve using humans and animals as subjects, and the data were not collected from social media platforms.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Data Availability**

Data extraction of nano silica as a potential filler in nanocomposites from rice husk ash with ballmill and coprecipitation methods (Original data) (Mendeley Data).

**CRediT Author Statement**

Eva Marlina Ginting: Data curation, Writing – original draft; Nurdin Bukit: Writing – review & editing; Motlan Motlan: Methodology, Investigation; Ridwan Abdullah Sani: Visualization, Investigation.

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