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Making micro particles from bamboo

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Abstract

Micro-particles have sizes ranging from 1 to 1000 µm. This research reveals the role of environmentally friendly bamboo micro-particles as biomaterials with engineered material characteristics. The study indicates that bamboo, when meshed to 300 and processed with a blender machine, results in micro-cracks on the bamboo surface. SEM morphology testing, bamboo under one year old and over one year old exhibits micro-particle shapes such as imperfect circles, elongated forms, and clumps. The micro-cracks lead to the breakage of covalent bonds in cellulose. The breakage of bonds is caused by photon energy entering the atom. The electrons within the atom become excited. Bamboo composition includes carbon, oxygen, hydrogen, and potassium. Additionally, functional groups such as phenol, alkane, alkene, and aromatic rings are also present in bamboo.

Keywords

Micro Particles, Bamboo, Blender Machine

Introduction

The development of materials using natural fibers is a relatively new group of materials [1]. Fiber is obtained from tree bark fiber, leaf fiber, seed fiber, fruit fiber, grass fiber, and wood fiber [1]. Fibers must have the mechanical, physical, and chemical properties of fibers. Local fiber selection has mechanical properties that can determine fiber selection. Natural fibers of use as composite and nano composite fiber materials. Top-down process method for making organic materials from large to small with micro or nanomaterial sizes. Meanwhile, fiber composites are natural fibers that have tensile strength. Meanwhile, micro or nanomaterials can produce energy [2].

Natural materials are very abundant [3, 4]. Natural materials are materials obtained directly from nature. Indonesia is considered a country with a high diversity of bamboo species, contributing to approximately 10% of the world's total bamboo population. It is estimated that half of the bamboo species in Indonesia are endemic, indicating a high level of specificity and diversity of bamboo in the country. There are approximately 176 bamboo species in Indonesia, classified into 24 genera. The diversity of bamboo species in Indonesia is estimated to be around 60 to 70 types, with the majority being

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considered distinctive features of Indonesia that are not found in other countries [5]. Bamboo resources are widely distributed in large quantities [2]. Bamboo has mechanical properties [1]. Bamboo is an organic material that contains the chemical contents of carbon, oxygen, and hydrogen [6]. These atoms bond with each other and form a honeycomb. Bamboo contains cellulose, hemicellulose, and lignin [1, 3, 7, 8]. These three main components contribute to approximately 90% of the total mass of bamboo [9]. The hydrogen bonds formed facilitate the structure of cellulose into a crystalline structure [10]. Monosaccharides are the simplest carbohydrate compounds used for energy. Oxygen binds cellulose into long chains and microfibrils when it is crystalline and forms noncrystalline parts [11]. Micro or nanotechnology refers to technology and applications in the real world [1]. Micro or nano has been researched in wood and bamboo, while bamboo needs further research [1].

The method used is a top-down method [8]. The top-down method changes the size of the material from large to small. This process uses mechanical properties. The first stage destroys the surface of the bamboo. The bamboo that has been ground is then blended until it is close to powder. Blend the bamboo, which has become powder again until smooth. Bamboo powder is then in mesh 200 and 300.

Bamboo is a plant that does not require maintenance. Bamboo can be helpful as a natural fiber and microparticle. The hexagon structure of cellulose can increase delocalized electrons. Bamboo microparticles are useful as composite microparticles and for energy production. Furthermore, this research aims to make bamboo microparticles. Bamboo microparticles are useful as microcomposites or energy harvesting

Methods

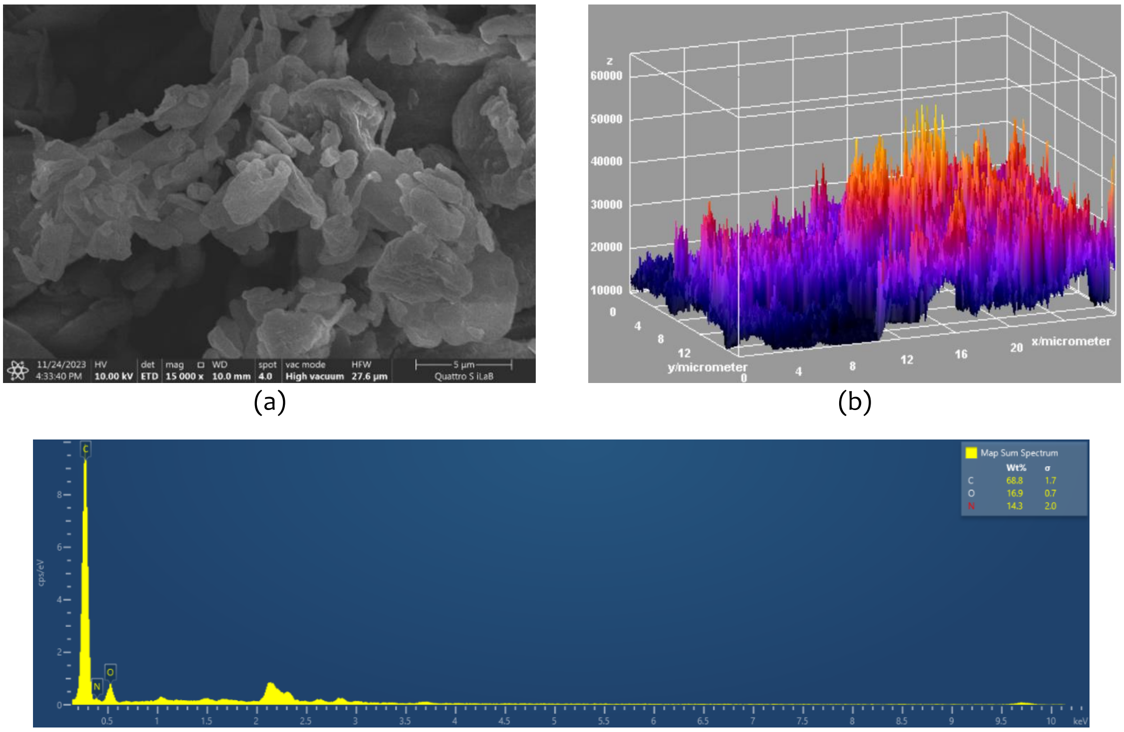
This research uses a top-down method. Bamboo microparticles can determine morphology and functional groups. SEM-EDX testing determines morphology and chemical composition. FTIR testing shows the functional groups contained.

The top-down method is a process of changing material from large to small with several process stages. The Blender process crushes the material into micro sizes. Meanwhile, the mesh for making it is 200 mesh (74 µm) of microfilter material. Bamboo that passes through a sieve is then stored. Bamboo that does not pass through the sieve is blended again until smooth. The bamboo is finely blended and then sieved with a mesh size of 200 (74 µm). Bamboo that passes through a 200mesh sieve is then stored. Next, the bamboo was sieved using a 300 mesh (50 µm). The bamboo that passes is stored, while the bamboo saved in the sieve is collected and blended once more.

Results and Discussion

SEM-EDX testing

SEM-EDX testing, the bamboo under one year old and over one year old has morphology and content result. Bamboo under one year as shown in the Figure 2 (a) the results of the SEM test at a 15,000x magnification indicate that microparticles bamboo with an age of less than 1 year exhibit elongated shape and imperfectly round shape. The elongated shape of the particles, containing chemical elements at the nanoparticle level, can bind to each other, forming a long structure. The imperfectly round shape of the particles has numerous angles on its surface, thereby reinforcing bonds with molecules and the chemical elements present in bamboo. Figure 1 (b) shows the surface contour of bamboo under 1 (one year). The surface contour is black to red to orange. Black contours indicate a more stable surface. Stable contour shows the surface does not easily interact or form clusters with other atoms. The surface contour shows that the material is hydrophobic. Bamboo has repulsive properties with solutions that tend to separate themselves. Figure 2 (c) bamboo under one year old has a carbon content of 68.8%, oxygen of 16.9%, and nitrogen of 14,3%. The resulting carbon content can increase the energy or strength of the material. Cellulose has aromatic and alkene rings. The rings appear inflated when exposed to heat energy. The double bonds in aromatic rings result from the photosynthesis process of plants.



(a) (b)

(c)

Figure 1. (a) Morphology bamboo under one year old (b) surface contours (c) content of bamboo under one year old

Bamboo over one year old as shown in the Figure 1 (a) the results of the SEM test at a 15,000x magnification indicate that microparticles bamboo with an age of less than 1 year exhibit clumping shapes. The clumps on microparticles could be attributed to the agglomeration process, where accumulation occurs during the grinding machine process. This accumulation leads to the occurrence of carbon (C) due to the mechanical reaction from the grinding machine process and chemical reactions involving the bonding of existing carbon (C) with newly formed carbon (C). Figure 2 (b) shows the surface contour of bamboo over 1 (one year). The surface contour is black to orange and a little white. Black contours indicate a more stable surface. Stable contour point that the surface will not interact or form clusters with other atoms. The surface contour shows that the material is hydrophobic and hydrophilic. Bamboo has the property of attracting forces with existing atoms. Figure 2 (c) Bamboo over one year old has a carbon content of 55.6% and oxygen 44.4%. The starch content contained in bamboo comes from photosynthesis [7]. Bamboo contains more polysaccharides [1]. Polysaccharides help bamboo grow big. Polysaccharides arranged in parallel originate from the formation of cellulose microfibrils. Hydrogen bonds connect cellulose microfibrils [12]. Bamboo that grows requires sufficient energy through sunlight (photosynthesis) and water absorption in the soil.

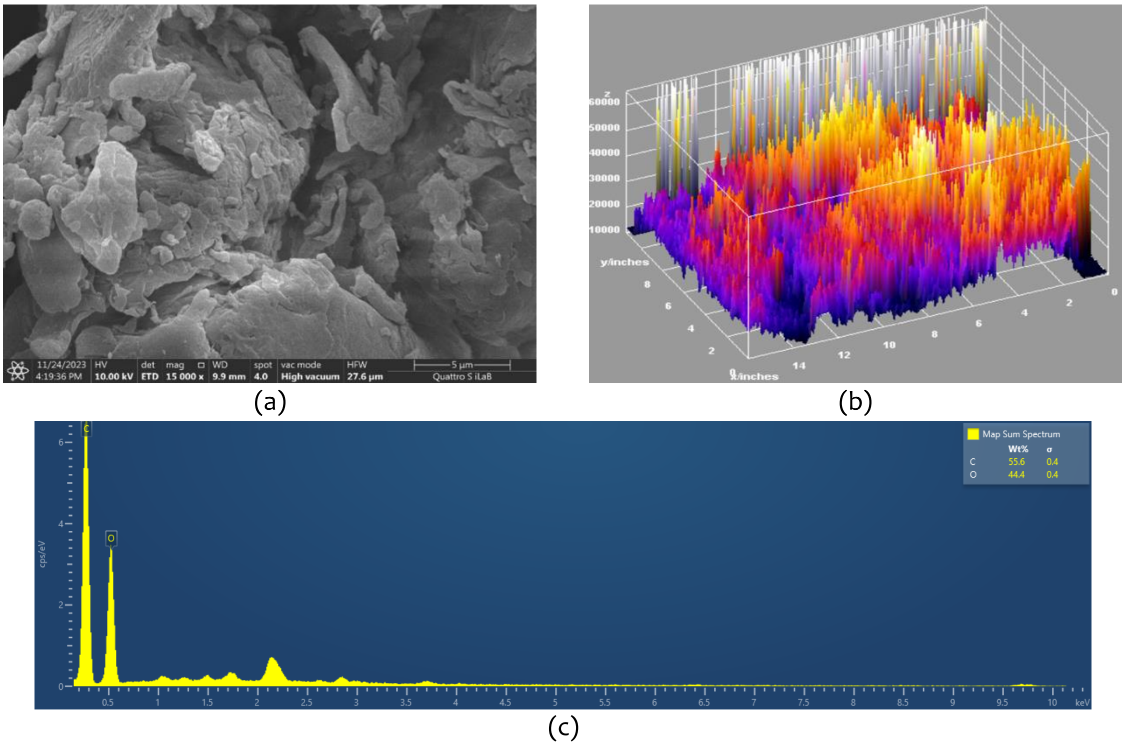


Figure 2. (a) Morphology bamboo over one year old (b) surface contours (c) content of bamboo over one year old

FTIR Testing

FTIR testing can determine the wave absorption and functional groups contained. The cellulose formed will form a crystalline area [10]. The crystalline area will shape cellulose and produce functional groups. Functional groups in cellulose alkenes, aromatic rings, carbon silicates, phenols, and esters [13]. C – H alkene functional groups, C = C aromatic rings, C – O carbonsylates and esters, C = C aromatic rings, and alkenes.

In Figure 3, black graphic lines show bamboo test results under one year. The black line indicates the relationship between wavelength and functional groups. C – H functional group 675 – 995 cm^{-1} alkene, C - H 690 – 900 cm^{-1} aromatic ring, C – O 1050 – 1300 cm^{-1} carbon silate and ester, C = C 1500 – 1600 cm^{-1} aromatic ring, and 1610 – 1680 cm^{-1} alkene. Trent is formed when new bamboo develops and creates a structure of cellulose, hemicellulose, and lignin. In addition, the carbon formed strengthens the hexagon structure. The oxygen contained is obtained from photosynthesis and inhaled water. The hydrophilic properties contained make it easier for bamboo to assemble.

In Figure 3, red lines show the results of bamboo testing over one year. The red line shows the relationship between wavelength and functional groups. C – H functional group 675 – 995 cm-1 alkene, 690 – 900 cm-1 aromatic ring, C – O 1050 – 1300 cm-1 carbon silate and ester, C = C 1500 – 1600 cm-1 aromatic ring, and 1610 – 1680 cm-1 alkene. Bamboo over one-year-old has a structure of cellulose, hemicellulose, and lignin. Bamboo begins to strengthen with its hydrophilic and hydrophobic properties. The stronger the hydrophilic content, the faster photosynthesis will run. The sun emits light in the form of photon energy. Bamboo, which has a functional group, attracts photon energy from the sun. The absorbed photon energy in the form of electrons enters the cellulose structure. In the cellulose structure, an attractive force occurs with photon energy. Photon energy enters the carbon atom, and electron delocalization occurs. Sun absorption is a phenomenon of the Grotthuss mechanism [14].

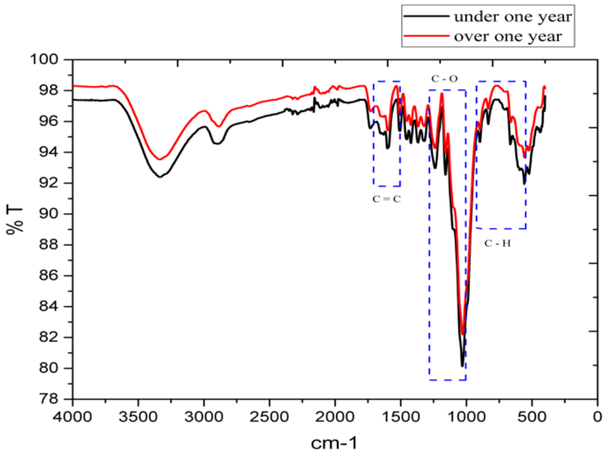


Figure 3. FTIR testing.

Conclusion

Preparation of bamboo micro-particles aged under one year and over one year have different morphologies, contents, and the same functional groups. Make bamboo micro-particles that are environmentally friendly and easy to obtain. Microparticles can develop as composite micromaterials, energy harvesters, and quantum information.

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