Plagiarism Checker X Originality Report

Similarity Found: 4%

Date: Monday, March 15, 2021
Statistics: 52 words Plagiarized / 1210 Total words
Remarks: Low Plagiarism Detected - Your Document needs Optional Improvement.

F U L L PAP E R www.ms-journal.de TheE?ectoftheAdditionofLacticAcidasaModi?er totheMorphologyandThermalPropertiesofCellulose NanoFiberPaper ElviKustiyah,MutiaAnissaMarsya,DickFerienoFirdaus,GerisPurwanto, andMochamadChalid* Thisstudydiscussesonanattempttocreateatransparentconductivepaper madebyafacileprocessandenvironmentallyfriendlycellulose-based sorghumasasubstituteforglasscoatinginthedisplayindustrythathasthe advantageofbeingabletobeformedandfolded.Sorghumstemswitha relativelyhighcellulosecontentofaround40%makeitapotentialmaterialto beusedasaconductivetransparentpaper.Theisolationofmicro?brillated cellulosefromsorghumstemwasteusingchemicalsandsonicationmethods toobtaincellulosenano?bril(CNF)withinananometersizerangeare discussedinthisresearch.Furthermore,lacticacid(LA)asamodi?erisadded withvaryingconcentrationstoexplorethee?ectofitsadditiononthe processingofthetransparentpapermadefromtheCNF.Characterizationin thisstudyincludesseveralaspects:toinvestigatethemorphologyoftheCNF paperiscarriedoutbyscanningelectronmicroscope.Inaddition,thermal strengthfortheproductisanalyzedusingthermalgravimetricanalysis.Itis foundthattheCNFpaperwith0.5wt%ofLAabletoincreasepaperdrying timewhilestillabletomaintainthemorphologyofthetransparentpaper. 1.Introduction Conductive paper is a breakthrough in smart-paper technol- ogy that can be developed as an electronic material as well as applications in the ?eld of renewable energy.

The nature of paper that can be folded, easy to print, and environmen- tally friendly is needed to increase the ?exibility of future elec- tronic product such as a conductive ?lm. Traditional transpar- ent ?lm layers such as indium thin oxide (ITO) is fragile and rigid,[1] hence cannot be used as a part for ?exible electron- ics.Therefore,inrecentyearsresearchonmaking?exible?lms has been successfully carried out, for example using materials E.Kustiyah,D.F.Firdaus,M.Chalid DepartmentofMetallurgyandMaterialsEngineering UniversitasIndonesia UIDepokNewCampus,Depok,WestJava16424,Indonesia E-mail:chalid@metal.ui.ac.id E.Kustiyah,M.A.Marsya,G.Purwanto ChemicalEngineering UniversitasBhayangkaraJakartaRaya2ndCampus Bekasi,WestJava17121,Indonesia DOI:10.1002/masy.201900157 suchasmetaloxidesemiconductors,[2] con- ducting polymers,[3] carbon,[4]graphene,[5] andmetalnanowire.[6-7] The biggest composition for paper mak- ingiscellulose.Themostnaturalcellulose- producing resources are in the stems of plants,trees,andagriculturalresiduessuch as rice husks, straw, etc.

Cellulose has a great potential to replace glass ?bers be- cause cellulose has high mechanical prop- erties such as sti?ness, impact resistance, ?exibility,andmodulus.[8] Theweaknessof paper, which is generally composed of cel- luloseisnottransparentbecausethediam- eterofthecellulose?berisgreaterthanthe wavelengthofvisiblelight.[9] Withthat,the use of paper is very limited to be applied in the electronic world.

In order to make thecellulosetransparent,the?bersizecan be made smaller by making nano cellu- lose.Manystudieshavestatedthatnanocel- lulose compare to its macro counterpart have increased crystallinity, aspect ratio, surface area and increased dispersion and biodegradation capa- bilities. [10-14] InIndonesia,thepotentialtoproducenaturalcellulose?bers is very high because this country has abundant plantation and forest products.

One of the natural ingredients that are devel- oping in its use in Indonesia is sorghum plants. In the world, sweetsorghumisthelargestplantationproductafterwheat,rice, corn,andbarley.CountriessuchasChina,theUnitedStates,In- dia,andevenAfrica,sweetsorghumcommoditieshavebeende- veloped for food as well as bioenergy.

So far, the use of sweet sorghum in Indonesia is only as animal feed and is still a fa- vorite of bioethanol research materials. Thus, sorghum which hasahighcellulosecontenthasthepotentialtobeusedinmak- ingconductivepaper. This research is focusing on the synthesis of the mentioned conductive paper called cellulose nano?bril (CNF) paper, in whichthenanocellulosewasisolatedfromthebulkcellulosethat came from sorghum waste using a crusher and further treated with alkali-bleach method and ultrasonication.

To increase the rate of CNF paper fabrication, lactic acid (LA) was added to ac- celeratethedryingprocess.LAisconsideredcompatiblewiththe cellulose ?ber and able to create stearic hindrance in between them, therefore it established spaces in the CNF morphology Macromol. Symp. 2020,391,1900157   Figure1. 1000 ×magni?cationofsecondaryelectron(SE)imagesofnanocellulosepapera)withoutLA;b)with0. 3wt%LA;c)with0.5wt%LA;d)with 0.8wt%LA which in return able to increase the overall drying time.[15] In thatcase,newstructureiscreatedandthereforeinvestigatedthor- oughlyinthisreport. 2.ResultsandDiscussions 2.1.CNFMorphology Figure 1a–cshowstheSEMimagesofthepapermorphologyat 1000 × magni?cation.

We can see that there is no e?ect of the LA to the morphologies of the paper, but there are some visible ?brillatedcellulosesofvarioussizeswithanaveragediameterof 6μm. [17] Thebiggest?brilsthatarehighlightedbywhitearrowsconsist of ?bers lump, which forms into a larger ?bril. It is suspected that from the process of making the CNF paper, the ?bers that wereoriginallynano-sized,agglomeratedbackintoMFC. 2.2.Modi?edCNFPaperwithLA The addition of lactic acid to the CNF paper aims to reduce the dryingtimeofpaperfabrication.

From the results combine in Table 1, the addition of lactic acid has reduced the drying time. The reason is that the con- Table 1. Dryingtimeofeachsample. Sample Drainingtime[min]in80 °C Reference 75 LA0.3% 65 LA0.5% 50 LA0.8% 60 densation polymerization (oligomerization) occurs between LA and hydroxyl groups of the CNF under high temperature and pressure.[18] The modi?cation of the CNF with LA, then de- crease the hydrophilic moieties and hence the water absorption is decreased.

From the results obtained, the fastest drying time achievedbytheCNFpaperwithLAcompositionof0.5wt%. 2.3.ThermalProperties Thermaltestsarecarriedouttoidentifythee?ectofaddingLAto thethermalbehavioroftheCNFpaper.Thistestisimportantto determine the degradation temperature and thermal resistance whenthesampleappliedasatransparentconductivepaper.Ther- mal stability of the CNF paper product is, therefore, studied by using TGA diagrams as indicated in Figure 2to investigate the Macromol. Symp. 2020,391,1900157   Figure 2. TGA curve of CNF and compare to the MFC extracted directly fromsorghumstem weight loss percentages in which correlated to its degradation temperature. Figure 2 shows the thermal behavior characteristic of un- treated sorghum and CNF paper with 0.5 wt % LA.

In the liter- ature,thermaldegradationofsorghumoccursat200–350°C,[19] whilethegraphshowsthattheMFCfromsorghumwithouttreat- mentbeginsslowlydecomposefrom250to450°CandtheCNF paper starts to decompose from 280 to 370 °C. In the Carvalho et al. trial,[20] cellulose decomposed starting at around 310 °C. Theincreaseindecompositiontemperatureisthoughttobedue tothereducednon-cellulosecontentinsorghum. 3.Conclusions CNF paper that fabricated using ultrasonicated MFC obtained fromsorghumstemwassuccessfullyproduced.Theadditionof LA to the CNF did not cause any morphological changes from the paper. By adding as much as 0.5 wt% of LA to the CNF, it canreducepaperdryingtimeupto25min.Thethermalstabil- ityoftheCNFpaperwasincreasedfromtheuntreatedsorghum, which indicated that the noncellulose content in the nanopaper waslessthanthereference. 4.ExperimentalSection Materials: Thesorghumstemwasobtainedfrom SEAMEOBIOTROP (Southeast Asian Regional Center for Tropical Biology)-Bogor.

The lactic acid (LA) used was 88% industrial grade that synthesized locally in the University of Bhayangkara, whereas sodium hydroxide (NaOH), sodium hypochlorite(NaOCl),andtechnicalqualityaceticacid(CH_3COOH)were boughtfromBrataco. ProcessingoftheSorghumStemWasteintoNanocellulose: Drysorghum stem waste was crushed with a crusher and then sieved with a 40-mesh sieve. Then the sample was treated with Alkali-bleach method developed by Aprilia et al.[16] The result produced micro ?brillated cellulose (MFC) with a size of 100 μm.

The MFC then dissolved in 300 mL of water in a beaker glass and allowed to rise for 24 h. Then it is inserted into the ultrasonicator bath for 15 min with 1500 watts of power. After the ultra- sonication, the colloid formed was centrifuged at a speed of 200 rpm in 10 min then 4000 rpm in 10 min.

The ?oating part (supernatant) which wastheCNFtransferredintothefreezertodrythenthedriedsamplewas characterizedandbroughttothenextstage. Process of the Addition of LA to Modify the Nanocellulose: CNFandLA were dissolved in water then homogenized using magnetic stirrer for 10 min. The LA addition to the CNF paper has three variations, which were 0.3, 0.5, and 0.8 wt%.

Colloids formed during the LA addition were then sonicatedwithsonicationtipswith600JmL -1 energyfor10min.Colloids formed after sonication were ?ltered with a PVDF membrane with a vacuumsystemtospeedupthedryingspeed. Fabrication of the Transparent Nanocellulose Paper: The CNF sample with the best drying speed was made into a transparent paper by adding waterandhomogenizedbyamagneticstirrerfor15min.Thecolloidwas thenpouredintoanacrylicboardanddriedinanovenat80°Cfor1h.

Characterizations: The?naltransparentnanocellulosepapermorphol- ogywasanalyzedusingascanningelectronmicroscope(SEM)atPTCipta MikroMaterial(CMM).Ontheotherhand,thermalpropertieswereana- lyzedusingthermalgravimetricanalysis(TGA)attheResearchCenterfor PhysicsoftheIndonesianInstituteofSciences(LIPI-FISIKA). Acknowledgements Thisworkwas?nanciallysupportedbyKementerianRiset,Teknologi,dan Pendidikan Tinggi Republik Indonesia (Ministry of Research, Technology andHigherEducationoftheRepublicofIndonesia).

Con?ictofInterest Theauthorsdeclarenocon?ictofinterest. Keywords lacticacid,nanocellulose,sorghum,transparentpaper,ultrasonication [1] A.Kumar,C.Zhou,ACSNano.2010,4,11. [2] K. Nomura, H. Ohta, A. Takagi, T. Kamiya, M. Hirano, H. Hosono, Nature2004,432,488. [3] C. Y. Kao, B. Lee, L. S. Wielunski, M. Heeney, I. McCulloch, E. Gar- funkel, L. C. Feldman, V. Podzorov, Adv. Funct. Mater. 2009, 19, 1906. [4] M.Kaempgen,G.S.Duesberg,S.Roth,Appl.Surf.Sci.2005,252,425. [5] H.Chang,G.Wang,A.Yang,X.Tao,X.Liu,Y.Shen,Z.Zheng, Adv. Funct.Mater.2010,20,2893. [6] A.R.Rathmell,B.J.Wiley,Adv.Mater.2011,23,4798. [7] Z.Yu,Q.Zhang,L.Li,Q.Chen,X.Niu,J.Liu,Q.Pei,Adv.Mater.2011, 23,664. [8] M. A.

Hubbe, O. J. Rojas, L. A. Lucia, M. Sain, BioResources 2008, 3, 929. [9] L.Hu,G.Zheng,J.Yao,N.Liu,B.Weil,M.Eskilsson,E.Karabulut,Z. Ruan,S.Fan,J.T.Bloking,M.D.McGehee,L.Wågberg,Y.Cui,Energy Environ.Sci.2013,6,513. [10] L. A. Berglund, P. Isaksson, T. Lindstrom, T. Nishino, Biomacro- molecules.2018,9,1579. [11] J.Jin,D.Lee,H.Im,Y.C.Han,E.G.Jeong,M.Rolandi,K.C.Choi,B. Bae,Adv.Mater.2016,28,5169.   [12] A. N. Aleshin, I. P. Shcherbakov, A. K. Khripunov, A. A. Tkachenko, I. N. Trapeznikova, V. N. Petrov, Flexible Printed Electron. 2017, 2, 035004. [13] D.

Lee, L. Young-Woo, I. Hyeon-Gyun, J. Seonju, J. Sangyoon, K. Yongho, C. Gwang-Mun, P. Jang-Ung, L. Jung-Yong, J. Jungho, B. Byeong-Soo,ACSAppl.Mater.Interfaces2017,9,24161. [14] F. Cheng, P. Lu, S. Chen, X. Yao, M. Lin, Y. Ou, D. Liu, J. Biobased Mater.Bioenergy.2017,11,125. [15] E. Afra, H. Youse?, M. M. Hadilam, T. Nishino, Carbohydr. Polym. 2013,97,725. [16]

S.Aprilia,C.Leo,Ismojo,S.H.A,MajalahPolim.Indonesia2017,20, 65. [17] A. Ismojo, D. Novovic, R. Lazwardi, A. Zul?a, M. Chalid, IOP Conf.

Ser.:Mater.Sci.Eng.2019,509,012079. [18] J.Sethi,K.Oksman,M.Illikainen,J.A.Sirvio,Carbohydr.Polym.2018, 197,92. [19] C. Qi, V. Yadama, K. Guo, M. P. Wolcott, Ind. Crops Prod. 2015, 69, 335. [20] W. S. Carvalho, I. F. Cunha, M. S. Pereira, Ind. Crops Prod. 2015, 74, 372. Macromol. Symp. 2020,391,1900157 ©2020WILEY-VCHVerlagGmbH&Co. KGaA,Weinheim 1900157(4of4)

INTERNET SOURCES:

<1% - https://www.researchgate.net/publication/318510717_Bio-Based_Fillers_for_Environmentally_Friendly_Composites
<1% - https://journals.sagepub.com/doi/pdf/10.1177/1934578X1801301206
<1% - https://www.academia.edu/14747037/The_origin_of_the_cosmic_soft_X_ray_background_optical_identification_of_an_extremely_deep_ROSAT_survey
<1% - https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=910238YI.TXT
1% - https://onlinelibrary.wiley.com/doi/epdf/10.1002/masy.201900074
<1% - https://iopscience.iop.org/issue/2053-1591/6/8
<1% - http://www.kaffee.50webs.com/Science/labs/Chem/Lab-Calorimetry.html
<1% - https://www.sciencedirect.com/science/article/pii/S1350417719314294
<1% - https://patents.google.com/patent/WO2017136714A1/en
<1% - http://www.ioffe.ru/LNEPS/publications.html