ABSTRAK

PERANCANGAN *SHIELDING ELECTROMAGNETIC INTERFERENCE* DENGAN MENGGUNAKAN KOMPOSIT *MICROCRYSTALLINE CELLULOSE-POLYURETHANE/CARBON NANOTUBE* (MCC-PU/CNT)

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Semakin banyaknya perangkat elektronik digital yang rentan terhadap noise menyebabkan kebutuhan akan pelindung EMI (EMI *shielding*) meningkat. Material pelindung EMI saat ini banyak dibuat dari bahan komposit berbasis sintetik yang kurang ramah lingkungan. Oleh karena itu, penelitian ini dilakukan untuk membuat pelindung EMI berbahan alami, yaitu serat dari batang singkong, yang merupakan limbah yang banyak ditemukan di Lampung. Serat batang singkong diolah menjadi Microcrystalline Cellulose (MCC) sebagai penguat komposit, dengan *polyurethane* (PU) sebagai matriks dan *carbon nanotube* (CNT) sebagai filler untuk meningkatkan konduktivitas. Komposit dibuat dalam lima variasi persentasi CNT terahadap berat PU yaitu 0%, 5%, 10%, 15%, dan 20%. Komposit yang telah dibuat dilakukan pengujian FTIR dan pengukuran S-parameter. Pengujian FTIR dilakukan pada komposit MCC-PU dan MCC-PU/CNT 20%. Hasil FTIR menunjukkan adanya gugus O-H dan C-H pada kedua sampel dan gugus C≡N pada sampel MCC-PU/CNT 20%. Pengukuran S-parameter dilakukan pada material komposit dengan menggunakan *vector network analyzer* (VNA) pada frekuensi 8 GHz – 12 GHz. Nilai S-parameter digunakan untuk memperoleh nilai *shielding effectiveness* (SE) dan resistansi komposit MCC-PU/CNT. Hasil SE terbaik dari lima sampel MCC-PU/CNT berturut-turut yaitu 0%, 5%, 10%, 15%, dan 20% adalah 10,23 dB, 13,09

dB, 15,88 dB, 20,40 dB, dan 36,22 dB. Berdasarkan hasil nilai *shielding effectiveness*, sampel MCC-PU/CNT 20% memiliki nilai SE yang paling tinggi. Untuk nilai resistansi, sampel komposit MCC-PU memiliki resistansi yang paling tinggi dan sampel MCC-PU/CNT 20% memiliki resistansi paling lebih rendah. Nilai resistansi berkorelasi dengan nilai *shielding effectiveness.* Material MCC-PU/CNT 20% memiliki resistansi yang paling rendah sehingga menghasilkan SE yang paling tinggi.

Kata kunci : *Electromagnetic Interference* (EMI), *Microcrystalline Cellulose* (MCC), *Polyurethane* (PU), *Carbon Nanotube* (CNT), *Shielding Effectiveness* (SE), *Vector Network Analyzer* (VNA).

ABSTRACT

DESIGN OF ELECTROMAGNETIC INTERFERENCE SHIELDING USING MICROCRYSTALLINE CELLULOSE-POLYURETHANE/CARBON NANOTUBE (MCC-PU/CNT) COMPOSITES

By

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The vast growth of digital electronic devices is vulnerable to noise pollution causing the necessity for EMI shielding solutions to become essential. Nowadays EMI shielding materials are mostly made using synthetic-based composite materials, which is environmentally unfriendly. Accordingly, this research studied the manufacture of an EMI shielding material from natural fiber, particularly fiber extracted from cassava stems, which is an abundant waste in Lampung. Cassava stem fibers were processed into microcrystalline cellulose (MCC) as a composite reinforcement, with polyurethane (PU) serving as the matrix and carbon nanotubes (CNTs) acting as the filler to enhance conductivity. The composites were made in five compositions, based on the variation of CNT percentage to the weight of PU: 0 wt%, 5 wt%, 10 wt%, 15 wt%, and 20 wt%. The composites were subjected to FTIR testing and S-parameter measurements. Fourier transform infrared (FTIR) spectroscopy was employed to examine the chemical composition of MCC-PU and MCC-PU/CNT 20 wt% composites. The FTIR results demonstrated the presence of O-H and C-H groups in both samples, as well as C≡N groups in the MCC-PU/CNT 20 wt% sample. The C≡N groups in MCC-PU/CNT 20 wt% indicate that the CNTs uniformly spread in the composites. The five samples undergone the S-

parameter measurements using a vector network analyzer (VNA) at frequencies ranging from 8 GHz to 12 GHz. The S-parameter values were used to obtain the shielding effectiveness (SE) and the resistance of the MCC-PU/CNT composite. The SE results from the five MCC-PU/CNT samples, namely 0 wt%, 5 wt%, 10 wt%, 15 wt%, and 20 wt%, respectively, are as follows: 10.23 dB, 13.09 dB, 15.88 dB, 20.40 dB, and 36.22 dB. The MCC-PU/CNT 20 wt% sample showed the highest SE value. The MCC-PU composite displayed the highest resistance, while the MCC-PU/CNT 20 wt% exhibited the lowest resistance. The lowest resistance of MCC-PU/CNT 20 wt% resulted in the highest SE.

Kata kunci : *Electromagnetic Interference* (EMI), *Microcrystalline Cellulose* (MCC), *Polyurethane* (PU), *Carbon Nanotube* (CNT), *Shielding Effectiveness* (SE), *Vector Network Analyzer* (VNA).