

ABSTRAK

STUDI PENGGUNAAN BIOKOMPOSIT SERAT TANDAN KOSONG KELAPA SAWIT DENGAN *FILLER* MWCNT SEBAGAI MATERIAL *SHIELDING* INTERFERENSI ELEKTROMAGNETIK

OLEH

BAMBANG SUTRISNO

Perkembangan perangkat elektronik yang semakin pesat menyebabkan meningkatnya interferensi elektromagnetik (EMI) yang dapat mengganggu kinerja peralatan. Oleh karena itu, diperlukan perlindungan terhadap EMI (*EMI shielding*). Penelitian ini bertujuan untuk mengembangkan material biokomposit berbasis serat alami yaitu serat tandan kosong kelapa sawit (OPEFB) yang dipolimerisasi polianilin (PANI) dengan resin epoksi *filler Multi-walled carbon nanotubes* (MWCNT) terfungsionalisasi sebagai material *EMI shielding*. Biokomposit difabrikasi dengan variasi OPEFB sebesar 10%, 20%, dan 30%, serta MWCNT sebesar 0%, 2%, dan 5% terhadap berat resin epoksi. Pembuatan spesimen berbentuk piring (*Dish-shaped*) digunakan untuk pengujian resistivitas volume, spesimen berbentuk planar persegi digunakan untuk pengujian FTIR, SEM dan *shielding effectiveness* (SE) menggunakan *Vector Network Analyzer* (VNA). Spesimen berbentuk kotak perisai digunakan untuk pengujian SE menggunakan antena *monopole*.

Hasil pengujian FTIR menunjukkan keberhasilan polimerisasi OPEFB dan fungsionalisasi MWCNT yang ditandai munculnya gugus fungsi C=C aromatik di 1500 cm^{-1} , serta gugus C–O pada 1028 cm^{-1} . Hasil pengujian SEM menunjukkan dispersi MWCNT yang homogen pada permukaan OPEFB. Komposisi OPEFB 10 – MWCNT 5 menghasilkan konduktivitas tertinggi sebesar $7,513 \times 10^{-8}\text{ S/m}$. komposisi tersebut juga menghasilkan nilai SE terbaik berdasarkan pengujian VNA sebesar $-5,708\text{ dB}$ pada frekuensi $6,6255\text{ GHz}$ dan pengujian antena *monopole* sebesar $-8,42\text{ dB}$ pada frekuensi 14 MHz . Hasil simulasi CST *Studio Suite* menunjukkan nilai SE tertinggi sebesar $-17,253\text{ dB}$ pada komposisi yang sama. Secara keseluruhan, hasil penelitian menunjukkan bahwa peningkatan konduktivitas material berkontribusi terhadap peningkatan kemampuan *shielding* interferensi elektromagnetik. Dengan demikian, biokomposit OPEFB dengan *filler* MWCNT berpotensi digunakan sebagai material *EMI shielding* yang ramah lingkungan.

Kata Kunci : *EMI Shielding, OPEFB, Multi-Walled Carbon Nanotubes, Shielding Effectiveness, Konduktivitas, Vector Network Analyzer, Antena Monopole*

ABSTRACT

STUDY OF OIL PALM EMPTY FRUIT BUNCH FIBER BIOCOMPOSITES WITH MWCNT FILLER AS AN ELECTROMAGNETIC INTERFERENCE SHIELDING MATERIAL

BY

BAMBANG SUTRISNO

The rapid development of electronic devices has increased electromagnetic interference (EMI), which can disrupt equipment performance therefore, protection against EMI, or EMI shielding, is necessary. This study aims to develop an EMI shielding material from biocomposite based on natural fibers specifically, oil palm empty fruit bunch fibers (OPEFB) polymerized with polyaniline (PANI) and epoxy resin incorporating functionalized Multi-walled carbon nanotubes (MWCNT) as a filler. The biocomposites were fabricated with OPEFB content of 10%, 20%, and 30% and MWCNT content of 0%, 2%, and 5% by weight of the epoxy resin. Dish-shaped specimens were used for volume resistivity testing; rectangular planar specimens were used for FTIR, SEM and shielding effectiveness (SE) testing using a Vector Network Analyzer (VNA); and box-shape specimens were used for SE testing using a monopole antenna.

FTIR test results indicate the successful polymerization of OPEFB and functionalization of MWCNT, as evidenced by the appearance of aromatic C=C functional groups at 1500 cm^{-1} and C–O groups at 1028 cm^{-1} . SEM test results show a homogeneous dispersion of MWCNT on the OPEFB surface. The OPEFB 10 – MWCNT 5 composition yielded the highest conductivity of $7.513 \times 10^{-8}\text{ S/m}$. This composition also provided the best SE performance, based on VNA testing at -5.708 dB at 6.6255 GHz and monopole antenna testing at -8.42 dB at 14 MHz . Simulation results from CST Studio Suite showed the highest SE value of -17.253 dB for the same composition. Overall, the research results indicate that increased material conductivity contributes to improved electromagnetic interference shielding capability. Thus, OPEFB biocomposites with MWCNT filler have the potential to be used as environmentally friendly EMI shielding materials.

Keyword : EMI Shielding, OPEFB, Multi-Walled Carbon Nanotubes, Shielding Effectiveness, conductivity, Vector Network Analyzer, Monopole Antenna