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Making an Active Carbon from Candlenut Shell for the Application of Electromagnetic Wave Absorbers

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Abstract— Making activated carbon using electromagnetic waves. characterization of electromagnetic wave material that will be carried out using candlenut shells as active carbon material. Activated carbon in question is carbon that has been activated by an activator so that the pores are open, so that the absorption of activated carbon is greater than ordinary carbon. The material is synthesized by carbonization and activation using chemicals KOH. Candlenut shell activated carbon is characterized using the Vector Network Analyzer (VNA) for testing Radar wave absorption by looking at the reflection coefficient value/RL with variations in material overlap in the range of frequency 4–8 GHz (C-band). The test results from the VNA used are those that have the maximum absorption power with the thickness used and the activation substances needed. The results of the research show that candlenut activated carbon can be used as Radar Absorber Material (RAM).

1. INTRODUCTION

Radar Absorber Material (RAM) is an important part of developing radar technology such as development the anechoic chamber for antenna characterization [1, 2]. Several methods have been used to increase radar wave absorption such as using a type of material as filler, engineering design and coating structure, as well as variations in coating thickness [3]. The value of Return Loss (RL) that is good for a material as a wave absorber is below −10 dB. This value can be interpreted that the reflected wave value is not too large compared to the emitting wave. This parameter value is one of the references to see whether the radar wave absorbent can work at the expected frequency or not [4].

The development of absorbent technology that has been developed previously is very expensive. On the other hand the development of carbon-based radar absorber materials has also been made in limited frequencies and narrow bandwidth [5, 6]. To overcome this problem, high dielectric materials are suitable for use as radar wave absorbent materials. In this study, the natural raw material used as a dielectric material came from candlenut shell carbon. Pecan shells are organic waste with a fairly hard texture because they contain carbon and are porous so they can be processed into activated carbon. The process of making activated carbon can be carried out through two stages, namely the carbonization process and the activation process. In this works, the effect of absorption of candlenut shell carbon waves on variations in material thickness, activation substance, and concentration (M) of the activation substance will be investigated.

2. METHOD

To produce activated carbon from the waste of candlenut shells, at first the candlenut shell is dried to reduce water content. Furthermore, candlenut shells are carbonized using incomplete combustion techniques (pyrolysis). This carbonization hook is then mashed using a blender and sieved with a size of 100 meshes. Furthermore, a KOH activating agent is used in the process of chemically activating candlenut shell carbon. The concentration of the activated substance was varied from 1 M to 5 M to determine the effect of concentration on wave absorption. Meanwhile, the thickness of the activated carbon material produced was also varied to determine the relationship of wave absorption from the material to the thickness of the material. Measurement of absorbency on microwaves is done by attaching material to acrylic molds with variations in thickness of 2 mm, 4 mm, 6 mm, 8 mm, and 10 mm. To measure the absorption of EM waves by materials, a VNA is operated in the material characterization process.

3. RESULT AND DISCUSSION

The effect of the carbon thickness on the absorption of the waves produced at each variation of concentration (M) can be seen from the reflection coefficient value. Characterization of candlenut activated carbon is carried out in the frequency range 2–8 GHz. The results of material characterization using the KOH activating agent are shown in Figure 1.

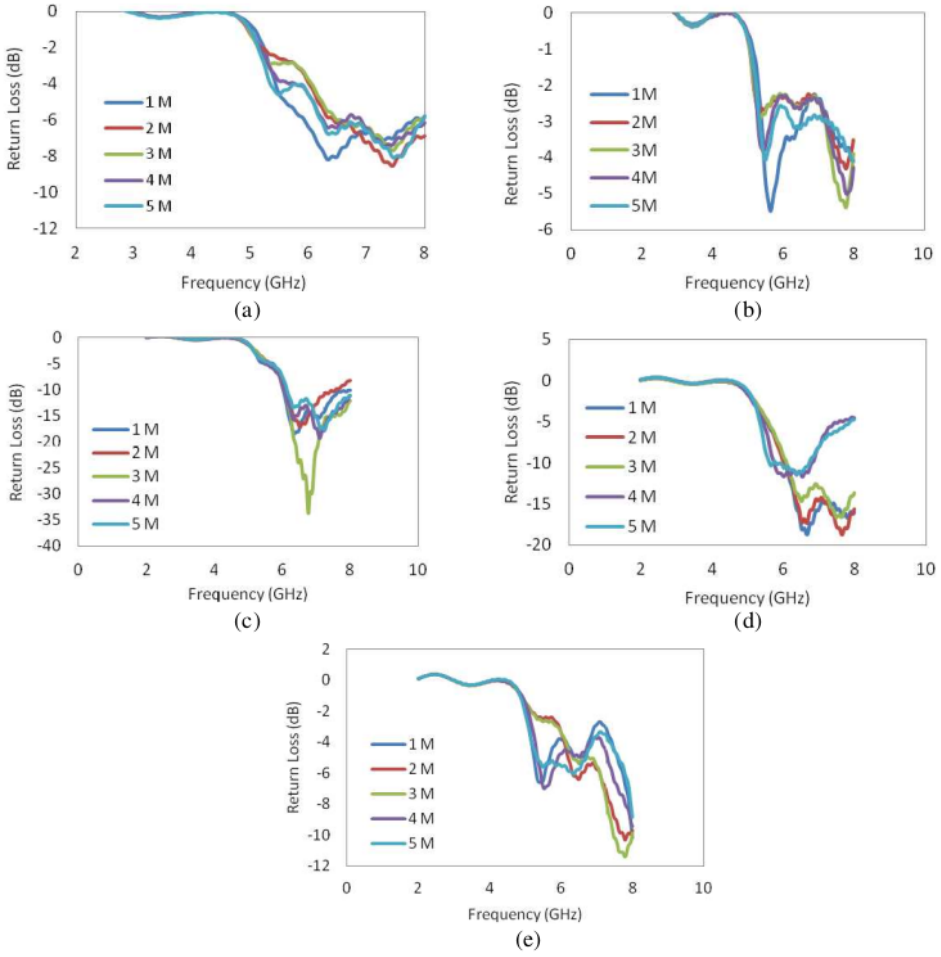

Figure 1. Measured results of return loss of the candlenut activated carbon for variation of the KOH concentration and carbon thickness (a) 2 mm, (b) 4 mm, (c) 6 mm, (d) 8 mm, and (e) 10 mm.

Table 1. Measured absorption of candlenut shell carbon for variations of thickness and concentration.

Activating agent Concentration	2 mm		4 mm		6 mm		8 mm		10 mm	
	RL dB	F (GHz)	RL dB	F (GHz)	RL dB	F (GHz)	RL dB	F (GHz)	RL dB	F (GHz)
1 M	−5.5	5.6	−8.21	6.3	−18.4	6.3	−18.7	6.6	−10.2	8
2 M	−4.33	7.7	−8.57	7.4	−17.2	6.5	−18.7	7.6	−10.3	7.7
3 M	−5.39	7.7	−7.7	7.4	−33.7	6.7	−16.7	7.6	−11.4	7.7
4 M	−5.02	7.8	−7.4	7.4	−19.3	7.1	−11.7	6.5	−9.44	8
5 M	−4.08	7.9	−8.11	7.4	−17.5	7.2	−11.4	6.3	−8.87	8

Figure 1 shows the maximum return loss of candlenut activated carbon is obtained −33.7 dB at the activating agent concentration of 3M, thickness 6 mm and center frequency 6.7 GHz. It shows

that at the concentration of 3 M activating agent, the number of pores formed in carbon material activating so that the surface of the material becomes wider. Meanwhile, for concentrations under 3 M, the number of pores formed in the carbon is few. Otherwise, the higher activating agent concentrations create a lot of pore and damage the surface of the material. As result, the wave absorption of the activated carbon will decrease.

4. CONCLUSION

The making an active carbon from candlenut shells for the application of electromagnetic wave absorbers has been realized. In this work, the carbon based on candlenut shell can be activated with KOH activating agent Measured results show the maximum return loss of candlenut activated carbon is obtained −33.7 dB at the activating agent concentration of 3 M, thickness 6 mm and center frequency 6.7 GHz. Based on this result, the absorption of electromagnetic waves of a candlenut shell activated carbon can be realized as radar absorber material in C-band working frequency.

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REFERENCES

1. Baharuddin, M. Z., Y. Izumi, J. T. Sri Sumantyo, and Yohandri, "Side-lobe reduced, circularly polarized patch array antenna for synthetic aperture radar imaging," *IEICE Trans. Electronic E99.C*, Vol. 10, 1174–1181, 2016.
2. Yohandri, J. T. Sri Sumantyo, and H. Kuze, "Circularly polarized array antennas for synthetic aperture radar," *Proc. Progress in Electromagnetics Research Symposium*, 1244–1247, Souzhou, China, 2011.
3. Zainuri, M., "Laporan akhir studi absorbsi elektromagnetik pada M-hexaferrites untuk aplikasi anti radar," Surabaya, ITS Surabaya, 2010.
4. Tsay, C. T., et al., "Investigation on electromagnetic and microwave absorbing properties of $La_{0.7}Sr.MnO_3$/carbon nanotube composites," *Journal of Applied Physics*, 107,09A502, 2010.
5. Zulpadrianto, Z., et al., IOP, *Conf. Ser.: Mater. Sci. Eng.*, 335 012002, 2018.
6. Yohandri, D. R. and A. Putra, "Study of single layer radar absorber material (RAM) based on coconut shell activated carbon," *2017 Progress In Electromagnetics Research Symposium — Fall (PIERS — FALL)*, 1536–1539, Singapore, Nov. 19–22, 2017.

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