Telecommunication Evaluation of Conductive Composite Plates

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Abstract

Two identical zigzag-shapes and an aluminum zigzag shape foil were combined as a slice testing piece. Each of the pieces was connected with AC. 110 V and AC. 12 V. The result indicated that the piece, whose tooth was 10mm wide with intervals of 15 mm, displayed an electromagnetic shielding effectiveness (EMSE) of 30 mG with the load current of AC. 110 V. The EMSE of another piece, whose teeth wide was 5 mm with intervals of 10 mm, was 20 mG in the load current of AC. 12 V. This result proved that samples were with EMSE under the alternating current.

Introduction

Electronic products nowadays are expected to be highly functional and with a smaller size. The more sophisticated a product is, the more circuit elements are equipped. The circuit elements are placed densely in order to fit the desired size. However, it also heightens the risk of mutual interference, especially the electromagnetic interference (EMI) [1-3]. Electromagnetic wave is believed to be not only carcinogenic, but also harmful to the central nervous system, the immune system and the cardiovascular system, blood, reproduction parts, heredity, and vision [4-6]. The second shielding is energy absorption. The electric dipole and magnetic dipole react with the electric field and magnetic field of the electromagnetic waves, so the original energy was worn out accordingly. For low frequency electromagnetic waves, energy absorption is more important than reflection attenuation. Usually, electricity facility is coated by a silicon steel plate or a magnetic permeable medal material to abate electromagnetic wave leakages and magnetic losses.

Industrial-grade functional textiles are the one of the major productive goals for textile industry in the application fields. From 2004 to 2010, Lin et al. have utilized fiber materials, nonwoven, Knit fabric and woven fabric in electromagnetic shielding effective products [7-17].

This study aimed to design and develop an EMSE material to lower threat of low frequency electromagnetic waves. Many EM SE products are available on the market; nevertheless, those costly products fail to prevent people from exposing to the low-frequency electromagnetic wave which is emitted from commercial frequency used by many daily electronic products. A series of experiments were conducted to find an efficient material to resist low frequency electromagnetic waves.

Experimental

Aluminum foils were cut into zigzag pieces in nine combinations of width/interval: 15 /15 mm, 15 /10, 15 /5 mm, 10 /10 mm, 10/ 5 mm, 5 /15 mm, 5 / 10 mm, and 5/ 5 mm. A nonwoven fabric was placed in between two pieces, completing the composite plate as shown in Figure 1. Two modules were connected with basic circuit in the alternating current of A.C 110 and A.C 12 V, and then changed its load current from 10 W to 200 W, evaluating the EMSE of zigzag samples.

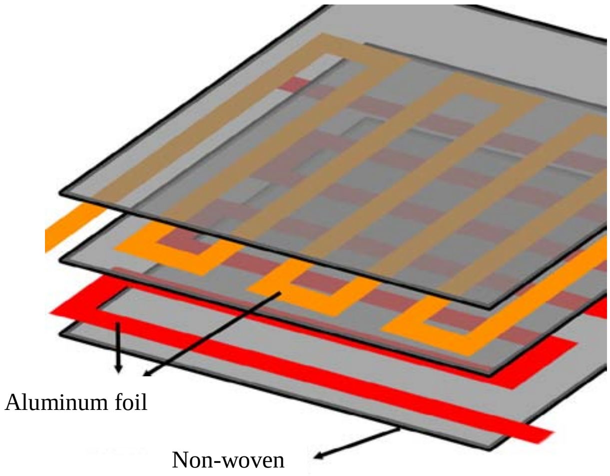

Figure 1 The composite plates of nonwoven fabric and two pieces of zigzag aluminum foils.

Results and Discussion

EMSE of composite plates with A.C 110V

A.C 110 V was used to create a load current ranging from 10 W to 200 W. Figure 2 reveals the statistics.

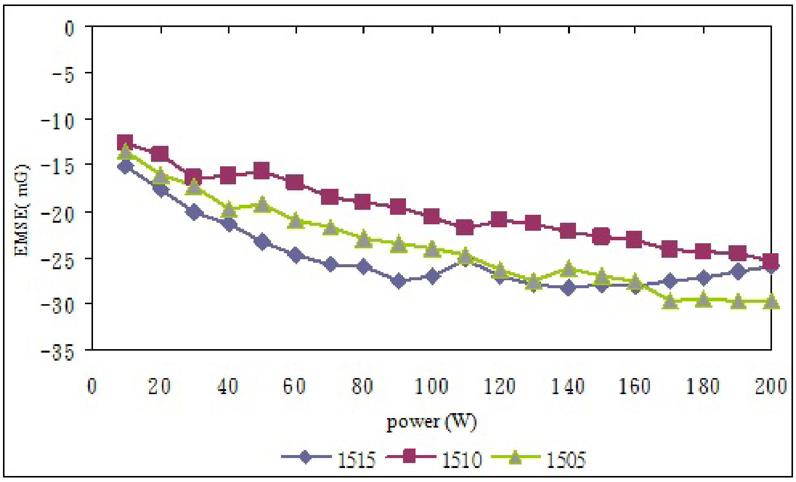

Figure 2 In A.C 110 V, the samples of 15 mm-wide teeth are tested with the piece of 15 mm, 10 mm and 5 mm intervals. The load current ranges from 10 to 200 W. (error: CV% 0.11-2.9)

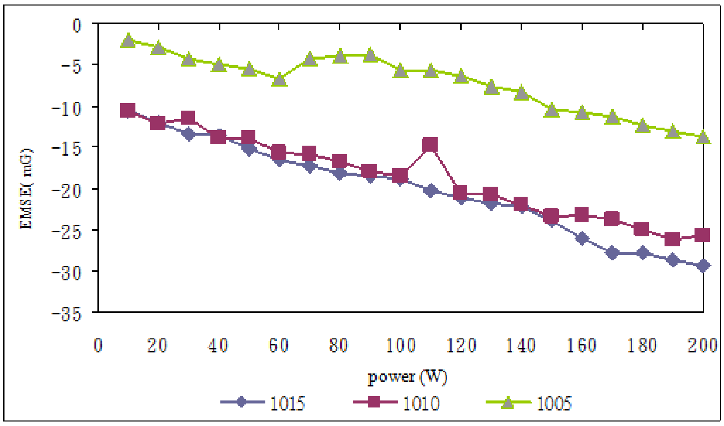

Figure 3: In A.C 110 V, the testing piece of 10 mm-wide teeth are tested with the piece of 15 mm, 10 mm and 5 mm intervals. The load current ranges from 10 to 200 W. (Error: CV% 0.11-0.33)

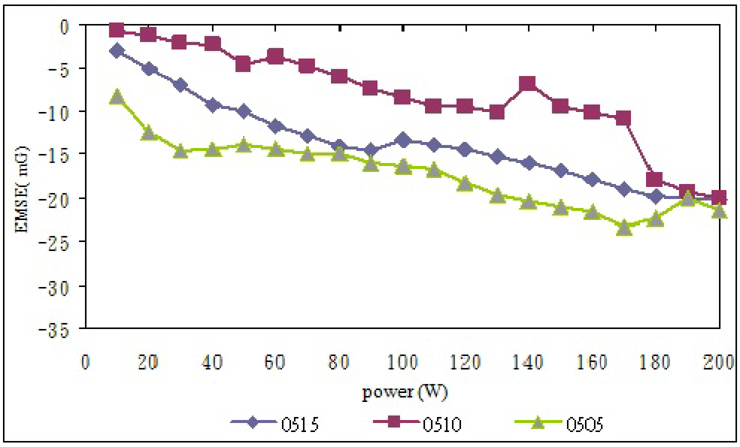

Figure 4: In A.C 110 V, the aluminum modules of 5 mm-wide teeth are tested with the piece of 15 mm, 10 mm and 5 mm intervals. The load current ranges from 10 to 200 W. (Error: CV% 0.11-2.9).

Figure 2 indicates that the 3 composite plates' EMSE. They were tested in load current ranging from 10 W to 160 W; their EMSE were increased with an increase in the load current. The EMSE of the plate, whose teeth is 15-mm-wide with 15 mm intervals, was lowered in the 160 W load current. Load current travelled largely in the aluminum module and resulted in greater electromagnetic waves. Consequently, the shielding effects were higher as well. Figure 3 demonstrates the 10-mm-wide plates in A.C 110 and 10 W to 200 W load current. The best result was gained in this 10mm-wide with 15 mm intervals. Figure 4 show the shielding effect of a 5 mm-wide plate in A.C 110V from 10 W to 200 W load currents. The shielding effect of a 5/ 5 mm plate was less satisfactory because only partial alternating current was allowed to pass the 5/5 mm plate. Small interval neutralized the current, giving a smaller shielding effect with the load current from 170 W to 200 W

EMSE of the composite plates with A.C 12 V

In the Figure 5, the best EMSE of the 10 mm/ 15 mm plates with A.C 12 V with 20 W load current. The 5/ 5 mm plate was of the worst EMSE. Smaller A.C resulted in greater EMSE. In the plate of 15 mm interval, its EMSE was only 16 mG. The EMSE of the 5 mm/5 mm plate was the worst because of its narrow width and interval. Bigger circuit resistance led to more neutralized electromagnetic wave. Consequently, the shielding effect decreased.

In the Figure 5, the shielding effect of the modules of 10 mm/10 mm and 15 mm/5 mm were up to 20 mG in A.C12 V/40 W. The shielding effect of the 5 mm/5 mm module was only 5.3 mG. In A.C 12 V, the shielding effect, regardless of modules, reached the top in 40W load current. With appropriate circuit resistance and intervals, the module was able to create the best shield effect.

As it shown in figure 5, the best and most notable shielding effect was achieved in modules of 5 mm/10 mm and 10 mm/10 mm in A.C 12 V with 50 W load current. The shielding effect was of the worst in the 5 mm/5 mm module. Bigger current created bigger electromagnetic waves; different intervals also neutralized the waves according to different distances, leading to different shielding effects.

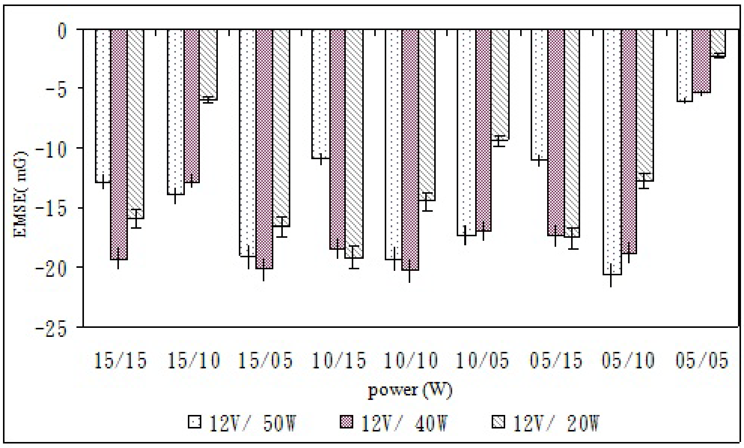

Figure 5: A. C 12 V was channeled in the modules of 5 mm, 10 mm and 15 mm-wide teeth are tested with the piece of 15 mm, 10 mm and 5 mm intervals. The load current ranges from 20, 40 and 50 W.

Conclusion

In this study, we manufactured the electromagnetic shielding conductive composite plates with nonwoven and aluminum foils successfully. In A.C 110 V, the 10 mm/15 mm zigzag pieces had the best shielding effect by creating 30 mG shielding effect in 200 W load current. In A.C 12 V, the best shielding effect was found in the 5 mm/10 mm module with a 50 W load current. The best shielding effect was 20 mG in the 10 mm/10 mm module with a 40 W load current.

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