Preparation and Study of Ferrite Electromagnetic Radiation Gypsum Board

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Abstract-Electromagnetic radiation pollution has become the fourth pollution sources on a threat to people's health. This paper selects ferrite as an absorbing agent, preparing a new anti-electromagnetic radiation gypsum board. The results show that, absorbing properties of gypsum board decreases first and then increases with the ferrite contents increases. When the ferrite contents was 25wt%, the absorbing properties of gypsum board was the best, the effective absorbing bandwidth was 5.586GHz when less than -5dB.

Keywords: ferrite; electromagnetic wave absorbing; absorbing agent; gypsum board; radiation pollution

I. INTRODUCTION

With the rapid of economic development, electronics, communications, computers and electrical equipment are finding their way into the family, resulting in the artificial electromagnetic energy of urban space increased year after year. Meanwhile, broadcasting and TV station, wireless transmitting stations, various types of antennas, electricity grid system, urban transportation, personal wireless communications tools and household appliances and so on, made people in an environment which was full of electromagnetic radiation. So, after air pollution, water pollution and noise pollution, electromagnetic radiation pollution has become the fourth pollution sources as a threat to people's health [1-4].

Ferrite is a magnetic loss absorbing materials with high magnetic loss angle tangent and high permeability, which has the ohmic loss, polarization loss, ion and electron resonance loss as general dialectic material, and also has its unique hysteresis loss, domain wall resonance, natural resonance loss and aftereffect loss mechanisms to absorb electromagnetic waves [5-10].

In this paper, ferrite is main absorbing agent to prepare a new type of anti-electromagnetic radiation gypsum board, and microwave absorbing properties and mechanical properties of these boards were investigated within 2-18GHz frequency range.

II. EXPERIMENTAL

In this study, absorbing performance of the samples with different content of ferrite were tested. Preparation processes of the anti-electromagnetic radiation gypsum board mixed with ferrite is as follows:

(1)Weighing gypsum clinker, ferrite, water, retarder according to the Table 1;

(2)Gypsum clinker mixed with ferrite powders uniformly; retarder mixed in water and stirred uniformly;

(3)Pour the mixed dry powder into the mixture, and stirred; 45 seconds later, the mixed material was poured into 180mm * 180mm * 10mm mold for molding, removed the mold after 1 day;

(4)The molding sheet was conveyed to oven, drying at 60 °C -70 °C for about 6 hours until it is 100% dry to obtain a ferrite gypsum composite.

TABLE I. FORMULA DESIGN OF ABSORBING TESTS WITH DIFFERENT CONTENT OF FERRITE

Sample No.	Gypsum (g)	Ferrite (g)	Retarder (%)	Water (g)	The ratio of water
F1	450	50	0.2%	225	0.45
F2	425	75	0.2%	212	0.424
F3	400	100	0.2%	200	0.4
F4	375	125	0.2%	180	0.36

III. RESULTS AND DISCUSSION

A. *Determination of Ferrite Electromagnetic Parameters*

The ferrite electromagnetic parameters were measured by Vector Analyzer instrument. Fig.1 to Fig.4 show the dielectric constant ε_r, dielectric loss tangent $\tan\delta_e$, complex permeability μ_r and permeability loss tangent $\tan\delta_m$ of ferrite under various frequency within 2-18GHz frequency range.

Fig.1 and Fig.2 show that the value of ε' was in the range of 5.64 to 5.85, the value of ε" is almost to zero. The change trend of ε" was similar to ε', which appeared two peaks and three troughs, and their position of the two curves appeared peaks and troughs were quite near. The value of $\tan\delta_e$ almost to zero, and the ferrite used in the experiment did not have the capacity of the dielectric loss.

In Fig.3 and Fig.4, the μ' decreased with the frequency increased overall, which near the range of 0.7-1.6. The values of μ" were in the range of 0.29 to 0.77. The trend of $\tan\delta_m$ was increased first and then decreased with the frequency increased, and the values were in the range of 0.19 to 0.69. which reached the maximum 0.6911 near the frequency 11.8GHz. The results shows that the absorption

peaks of gypsum mixed with the ferrite might appeared near the frequency 11.8GHz.

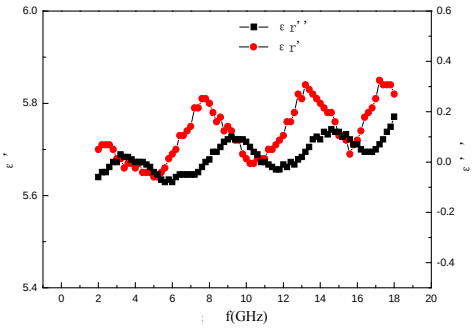

Figure 1. The dielectric constant of the ferrite

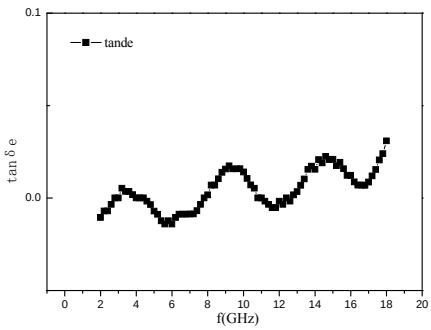

Figure 2. The dielectric loss tangent of the ferrite

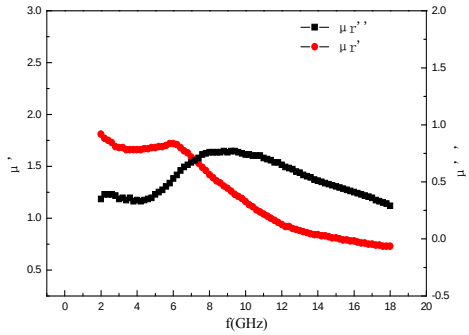

Figure 3. The complex permeability of the ferrite

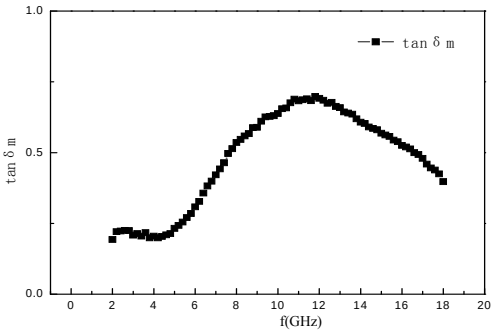

Figure 4. The permeability loss tangent of the ferrite

B. *Absorbing Performance Testing of Ferrite Gypsum Composite*

Fig.5 is the curves between the frequencies and the reflectivities of ferrite with different contents. And Fig.6 described the wave bandwidth of composite system at different contents. From Fig.5 and Fig.6, it could be seen absorbing properties of the system increased first and then decreased with the ferrite contents increased. When the ferrite content is 25wt%, absorbing properties of the composite system was the best, and the absorbing bandwidth was 5.586GHz, the maximum absorption peaks were -15dB and -11.5dB at 10.32GHz and 17.12GHz respectively.

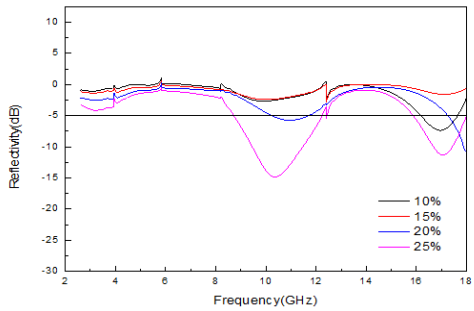

Figure 5. The effect of the ferrite contents on reflectivity

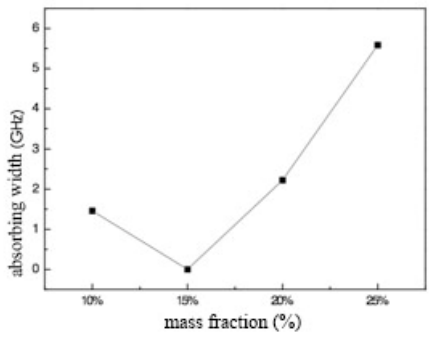

Figure 6. Absorbing bandwidth of composite of gypsum and ferrite

The reasons for these results are as follows: with the ferrite content increased gradually, the permeability of system has increased, and the absorbing property has also improved. But the phenomenon of the impedance mismatch might appeared, which cause the sample of 15% ferrite contents absorbing properties lower than the sample of 10% ferrite contents. However， Continued to add ferrite, the hysteresis loss of ferrite enhanced and the absorbing properties of the system has been improved.

IV. CONCLUSION

Through the absorbing performance testing, absorbing properties of the system decreased first and then increased with the ferrite content gradually increased. When the ferrite contents was 25wt%, the system has the best absorbing properties. The -5dB bandwidth of the sample is 7.1311GHz, and the maximum absorption peak -18.467dB.

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