

CONFERENCE PROCEEDING

## Materials' Characterization of Electromagnetic Wave Absorber in Reducing the Electromagnetic Interference Pollution- A Review

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### ABSTRACT

The usage of electronic devices in our daily lives is increased to have a better life with many solutions provided by the devices in this modern era where it led to an electromagnetic interference that affect our health. Therefore, many researchers have an interest in synthesizing an electromagnetic interference absorbing material that can provide the maximum benefits to the society. This short review paper will be discussed on different materials can be used to reduce the electromagnetic interference pollution apparently by identifying the materials' characterization such as the reflection loss, morphological and structural properties. The methods used in preparing the materials also had come into discussions that has become one of the factors affecting the performance of absorbing the electromagnetic interference. Different structure that enhances the properties of absorbing the electromagnetic wave is also highlight in this short review. These different types of morphologies of the materials play an important role in determine the material performance where it could provide mechanisms in absorbing the electromagnetic interference. The doped materials also help the main materials to exhibit their capabilities as an electromagnetic absorbing material.

**Keywords:** *electromagnetic interference, morphology, reflection loss.*

### INTRODUCTION

It is challenging to live in this modern era in addition with the fourth industrial revolution where it requires us to find and implement various solution for us to survive in the fast-paced modern civilization. There are many inventions created nowadays that help to ease our daily life such as various electronic devices that are widely used as communicating devices such as smartphones and commercial devices lie microwaves. However, those devices can provide a large impact to us as it has the electromagnetic interference that can harm our health such as headache and sleeping disorder (Vineeta Shukla, 2019). This is very menacing because it is obviously cannot be resisted that we tend to not be separated from those devices as it helps us to complete many important tasks. Therefore, electromagnetic absorbing materials can make this situation better by absorbing the unwanted signals results in less electromagnetic interference pollution. Many researchers are working in finding the best materials that has the potentials and capabilities to exhibit an excellent performance as an electromagnetic absorbing material. There are many aspects of the materials such as the morphology, reflection loss and the thickness have come into considerations among researchers which lead to different result in absorbing the electromagnetic interference.

## MATERIALS AND METHODS

There are various materials used as filler and absorb the electromagnetic wave interference pollution. The example of materials used as filler, matrix, ratio between filler and matrix and method of preparation is list in Table 1.

**Table 1.** Different materials used as filler

Filler	Matrix	Ratio wt % (filler:matrix)	Method preparation	References
RGO/ SrFe <sub>12</sub> O <sub>19</sub>	Paraffin	7:3	Hydrothermal	Shumin Du <i>et al.</i> , 2020
ZnCo <sub>2</sub> O <sub>4</sub>	Paraffin	7:3	Solvothermal	Jianwei Wang <i>et al.</i> , 2020
NiCo/CoNiO <sub>2</sub>	Paraffin	1:3	Hydrothermal	Xinfeng Zhou <i>et al.</i> , 2020
GNS@CoFe <sub>2</sub> O <sub>4</sub>	CNT Aerogels	1:3	Solvothermal	Fang Ren <i>et al.</i> , 2018

## RESULTS AND DISCUSSION

Different materials used as filler and matrix exhibiting different reflection loss performance due to their capabilities in absorbing the electromagnetic interference as shown in Table 2. The coating of graphene on SrFe<sub>12</sub>O<sub>19</sub> nanoflakes helps the SrFe<sub>12</sub>O<sub>19</sub> supported on the RGO sheet to show better dispersibility than pure SrFe<sub>12</sub>O<sub>19</sub>. Defects such as defect polarization and electron dipole relaxation can occur due to many residual oxygen-containing functional groups on the surface of reduced graphene. On the other hand, different preparation temperature of flowerlike structure of ZnCo<sub>2</sub>O<sub>4</sub> results in different absorbing performance. This shows that the effectiveness of the electromagnetic absorbing material can be increased by modifying the structure and morphology of the substance. There are different morphologies of ZnCo<sub>2</sub>O<sub>4</sub> that may affect its performance due to different capabilities as an electromagnetic absorbing material such as cabbage-like shape and pineapple-like shape.

Other than that, nanoflower-like morphology of NiCo/CoNiO<sub>2</sub> with increasing conductive loss for attenuating electromagnetic wave energy are provided by the porous carbon skeleton structure which could be found from all the carbon materials. Other reports also show that the breakage of the graphite lattice structure state can be occurred by the increasing amount of CoNiO<sub>2</sub> and NiCo alloy which will lead to the introduction of more defects of carbon materials. The dipolar polarization loss for attenuating electromagnetic wave energy can be increased by the increment of the defects. Interface polarization loss for attenuating electromagnetic wave can be introduced by the plenty of heterojunction interface among NiCo alloy nanospheres, CoNiO<sub>2</sub> nanoflowers and porous carbon. GNS@CoFe<sub>2</sub>O<sub>4</sub>/CNT with open and highly porous structure and the presence of dihedral angles from the dense interlinked CNTs in the 3D foam and the special structure of GNS@CoFe<sub>2</sub>O<sub>4</sub> can consume incident waves by making it undergo multiple reflection and scattered inside the foam structures. Larger loss of electromagnetic energy can be produced by making the propagation path of electromagnetic waves prolonged because of the multiple

reflections of electromagnetic waves. Strong absorption and weak reflection can be obtained from the improved impedance match characteristics due to the addition of GNS@CoFe<sub>2</sub>O<sub>4</sub> which could exhibit high magnetic loss by eddy current

**Table 2.** Reflection loss performance of different materials

Filler	Thickness (mm)	Frequency (Hz)	Reflection loss (dB) and bandwidth (GHz)	References
RGO/ SrFe <sub>12</sub> O <sub>19</sub>	1.5	14.7	-48.1, 3.9 (12.9-16.8 GHz)	Shumin Du <i>et al.</i> , 2020
ZnCo <sub>2</sub> O <sub>4</sub>	2.4	16.96	-43.61, 7.12 GHz	Jianwei Wang <i>et al.</i> , 2020
NiCo/CoNiO <sub>2</sub>	3.8	6.32	-74.3	Xinfeng Zhou <i>et al.</i> , 2020
GNS@CoFe <sub>2</sub> O <sub>4</sub>	3.0	11.22	-29.1, 3.47 GHz	Fang Ren <i>et al.</i> , 2018

## CONCLUSION

Various materials used as an electromagnetic wave absorber in reducing the electromagnetic interference pollution. However, many aspects need to be taken into consideration and play an important role in determining the capabilities of an effective electromagnetic wave absorbing materials. Different aspects such as the materials, morphology of the materials, doping materials, reflection loss and as well as the method used in preparing it will determine the potential materials to exhibit the best performance in absorbing the electromagnetic interference pollution. The pure metals that have been enhanced with other materials such as PVP and RGO helps the materials to grow various nanostructures for attenuating the electromagnetic interference. Thus, electromagnetic interference pollution may be reduced by using potential electromagnetic wave absorber.

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