

Investigation of factors influencing the efficacy of electromagnetic shielding in X band frequency range

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Abstract

Introduction: Due to the importance of engineering controls for prevention of microwave exposure, this study was conducted to design and construct a novel electromagnetic shielding and also to examine the factors influencing shielding efficacy in X band frequency range.

Material and Method: This study used Resin Epoxy as matrix and nano-Nickel Oxide as filler to prepare the composite plates with three different thicknesses (2,4, and 6 mm) and four different weight percentages (5,7,9 and 11). The fabricated composites characterized using X-ray diffraction and Field Emission Scanning Electron microscopy. Shielding effectiveness, percolation depth, and percolation threshold were measured using Vector Network Analyzers. Thermal Gravimetric Analysis was conducted to study the temperature influence on weight loss for fabricated composites.

Result: A maximum shielding effectiveness value of 84.18% was obtained for the 11%-6mm composite at 8.01 GHz and the 7%-4mm composite exhibits a higher average of shielding effectiveness of 66.72% at X- band frequency range. The 4mm thickness was optimum and critical diameter for composite plates; and percolation depth was obtained greater than thickness of composites. However, increasing the nickel oxide content did not show noticeable effect on the shielding effectiveness. Thermal Gravimetric Analysis showed that the study shields were resistant to temperature up to 150 °C without experiencing weight loss. What is more, the results indicated that Nickel oxide Nano particles had desirable distribution and dispersion in epoxy matrix and percolation threshold was appeared in low content of nickel oxide nanoparticles.

Conclusion: A novel electromagnetic shield using low thickness and few content of nanoparticle with noticeable efficacy was properly designed and constructed in the field of occupational health. In addition, this shield has low cost, easy to manufacture, resistance to wet/corrosion, and low weight. Epoxy/nickel oxide composite can represents a new generation of electromagnetic shielding, which is considered as a promising candidate for occupational protection against microwave exposure. It is recommended that future studies improve the shielding effectiveness by decreasing the percolation depth and investigate the efficacy of the fabricated shield in the workplaces.

Keywords: Composite Shielding, Electromagnetic, Microwave, Nickel Oxide, Occupational Protection

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