Study for Electromagnetic wave Absorbing Materials Made by Melt-Dragging Process

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The advance of information-communication increases the usage of microwaves in the ㎓ range because of the demand for transmission of large amounts of data. Particularly, mobile phones and local area network systems, which use the electromagnetic wave of 0.5-5 ㎓ range, have been rapidly growing. The higher electromagnetic wave ranges are also anticipated for LAN systems, satellite broadcasting system, and radar system etc. Consequently, the problem of electromagnetic interference has become increasingly serious, and therefore much attention has been paid to the electromagnetic wave absorbers to solve the problem. A thin electromagnetic wave absorber was demanded with high value of relative complex permeability ($\mu_r = \mu_r' + j\mu_r''$) and permittivity ($\varepsilon_r = \varepsilon_r' + j\varepsilon_r''$). Particularly, a large imaginary permeability (μ_r'') is required for a high characteristic electromagnetic wave absorber.

In this study, various permalloy alloys with high permeability were designed, melted in a high frequency induction furnace in air, melt-dragged into flakes, crushed into powders by a vibration mill, deformed into ultra-thin flakes by a attrition mill. The flake powders were then mixed with silicon rubber and formed into a sheet. The electromagnetic wave absorbing characteristics of the sheet were measured with a Network Analyzer, and the magnetic properties of the powder were measured with a VSM.

The crushed powder of a 79 permalloy exhibits Ms 65.7 emu/g and Hc 58Oe. The aspect ratio (diameter/thickness) of the flake increases with attrition milling time. The larger aspect ratio fits for higher resonance frequency because of the larger shape anisotropy. When the powders were attrition-milled for four hours at 600 rpm, the aspect ratio of the flake became 20 ~30. When this flake was mixed with a silicone rubber and formed into a 1 mm thick sheet, the reflection loss at 0.8 ㎓ was –2.7dB. It is an excellent absorption of electromagnetic wave. The relationship between alloy/aspect ratio and relative permeability/permittivity/reflection loss will be described. Further absorption of electromagnetic wave possible with better-controlled aspect ratio and recovery heat treatment will also be described.

References

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