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Processing of a paint based in hybrid material for use as Radar Absorbing Material

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Abstract – The objective of this work is the processing of radar absorbing materials (RAMs) with a hybrid matrix (electric and magnetic) and in the form of a paint. The produced formulation was painted on metal surfaces; the RAMs were then characterized with regard to the absorption of electromagnetic radiation, electric permittivity and magnetic permeability. The processed RAMs attenuated the incident energy between 35% and 75%.

Conductor and semiconductor materials have been extensively studied with the purpose of extending their use to microelectronics in order to eliminate and/or shield this type of equipment against spurious radiations and to control the effects of these radiations on living organisms. Also, the military industry requires that the radar return signal of certain types of targets be attenuated as much as possible. To this end, radar absorbing materials (RAMs) are employed in camouflage system. RAMs are classified in two types depending on the way the electromagnetic wave interacts with the material. RAMS are classified as materials with dielectric losses or magnetic losses when the electric field or magnetic filed component of the wave, respectively, interacts with the material. RAMs can also be produced as a hybrid material when these two types of material are used simultaneously. In this paper, it is described the production of a hybrid RAM in the form of a paint and based on a formulation containing polyaniline (conducting polymer), carbonyl iron (15% w/w, both compounds) and polyurethane resin applied to the surface of flat aluminum plates. The measured thickness of the paint layer was 2.20 mm. The processed materials were evaluated considering the attenuation of incident electromagnetic radiation in the frequency range of 8-12 GHz (X-band) using the waveguide and the NRL (Naval Research Laboratory) techniques. The determination of electric permittivity (ε) and magnetic permeability (μ) of a material is usually based on measurements of complex electromagnetic parameters, the reflection and transmission coefficients (S_{11} and S_{21}, respectively), using a vector network analyzer with waveguide. To analyze the material using the NRL arch, plates measuring 20 cm x 20 cm were prepared. Fig. 1 shows the experimental measurements of electromagnetic absorption by the processed materials. Fig. 2 shows the complex permittivity and permeability of the materials as function of frequency. The results from the NRL measurements are shown in Fig. 3. The maximum measured absorption of the RMA paints was about 75% (6 dB). It can be observed that the profiles of complex values related to the relative electric permittivity are: 5.5 and 1.5 for real (ε') and imaginary (ε") parts, respectively. Magnetic permeability values are: 1.2 and about 0.2 for the real (μ') and imaginary (μ") parts, respectively. The results obtained for the processed materials were expected since the high conductivity of the formulation is similar to that of metals. The attenuation obtained with the processed materials indicates that these materials have the potential to be used in RAM application.

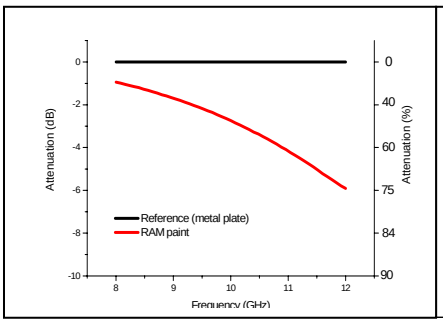

Figure 1: Attenuation of RAM paint by waveguide measurements.

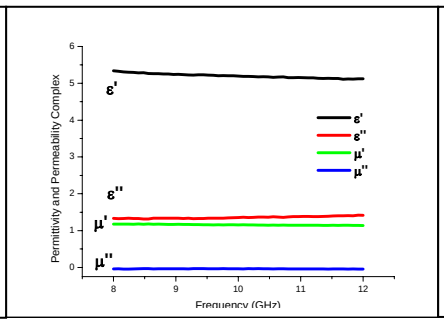

Figure 2: Permittivity and permeability complex

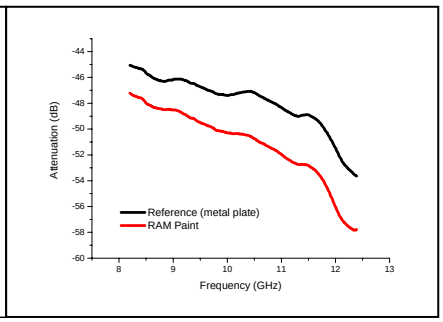

Figure 3: Attenuation of RAM paint by NRL measurements

References

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