Electromagnetic Multifunctional Composites High Impedance Surfaces

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Motivation

The push for electromagnetically functional composites has been strong for applications where space is at a premium. Composites fit the task well as they are lightweight, strong, and have tailorable properties. One such application are High Impedance Surfaces which have the ability to reflect waves in phase when placed near a radiating element.

- Strong and lightweight
- Tailored Electromagnetic Properties
- Laminate construction

APPRAOCH

Compare traditional Printed Circuit Board (PCB) fabrication to a structural composite system through tensile properties ASTM D3039.

PCB (Rogers 4350C)
- Excellent dielectric properties
- Low strength

Composite (Tencate BTCy-1 Cyanate Ester/S-glass)
- Good dielectric properties
- High Strength

Structural reduction comes from the inclusion of the drilled vias acting as an array of open holes in the tension specimens. From here guidelines for hole size and spacing can be made for EM design geometry.

PROCESSING

Copper-clad PCB material is commercially available while the composite case had to be fabricated from prepreg using an autoclave processing. PCB and composite systems were sent out etched and drilled for vias. Both systems have similar dielectric properties as well as thickness. EM design geometry was the same for each.

HIS designed and modeled using HFSS. Final HIS materials were measured in an anechoic chamber to confirm EM properties.

EM Testing

Testing was completed loading samples until failure in tension ASTM D3039. Structural properties were measured and compared on both the gross area of the entire sample and the net area at the line of holes.

Mechanical Testing

S-glass/ Cyanate Ester Failure

Modulus tracked with area reduction while net strength between the holes tends to be lower than the ultimate strength due to notch sensitivity and stress concentrations. Future tests will compare hole size, spacing, and loading directions in order to make a more complete guide for EM design.

Discussion

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