

Fabrication and Characterization of Ceramic Matrix Composite

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Abstract : Ceramic-matrix composites (CMC) have significant prominence in various engineering applications because of their heat resistance associated with an ability to withstand the brittle type of catastrophic failure. In this study, specific raw materials have been chosen for the purpose of having suitable CMC material for high-temperature dielectric applications. CMC material will be manufactured through the polymer infiltration and pyrolysis (PIP) method. During the manufacturing process, vacuum infiltration and autoclave will be applied so as to decrease porosity and obtain higher mechanical properties, although this advantage leads to a decrease in the electrical performance of the material. Time and temperature adjustment in pyrolysis parameters provide a significant difference in the properties of the resulting material. The mechanical and thermal properties will be investigated in addition to the measurement of dielectric constant and tangent loss values within the spectrum of Ku-band (12 to 18 GHz). Also, XRD, TGA/PTA analyses will be employed to prove the transition of precursor to ceramic phases and to detect critical transition temperatures. Additionally, SEM analysis on the fracture surfaces will be performed to see failure mechanism whether there is fiber pull-out, crack deflection and others which lead to ductility and toughness in the material. In this research, the cost-effectiveness and applicability of the PIP method will be proven in the manufacture of CMC materials while optimization of pyrolysis time, temperature and cycle for specific materials is detected by experiment. Also, several resins will be shown to be a potential raw material for CMC radome and antenna applications. This research will be distinguished from previous related papers due to the fact that in this research, the combination of different precursors and fabrics will be experimented with to specify the unique cons and pros of each combination. In this way, this is an experimental sum of previous works with unique PIP parameters and a guide to the manufacture of CMC radome and antenna.

Keywords : CMC, PIP, precursor, quartz

Conference Title : ICEAST 2022 : International Conference on Engineering, Applied Science and Technology

Conference Location : Oslo, Norway

Conference Dates : June 23-24, 2022