MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

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CRYOGENIC PROPERTIES OF CARBON FIBER REINFORCED COMPOSITES SUPPORT STRUCTURE

Abstract

To meet the design goals for low thermal conductivity and light weight, carbon fiber reinforced polymeric based composites are being explored for cryogenic support element applications. One potential application is the truss connected LH2 and LOx tank. To realize the potential weight savings from the use of polymeric composites, it is important to know the performance of the candidate material at cryogenic temperatures to ensure safety and reliability. A T800 carbon fiber reinforced epoxy based composite (CFRC) support structure for cryogenic fuel storage tank was fabricated by prepreg tape winding. Mechanical properties of resin cast, CFRC unidirectional laminate and support structure were measured at ambient and cryogenic temperatures respectively. The thermal conductivities of unidirectional laminate between 20K and 300K were measured while those of the support structure at 77K and 20K were calculated based on thermal conductivity data of unidirectional laminate. The ratio of strength to thermal conductivity was used to assess the suitability of fiber reinforced laminates for support structures at cryogenic temperatures. The relationship between temperature and mechanical properties were discussed. The results indicated that cryogenic mechanical properties of unidirectional laminate are better than at ambient. Cryogenic tensile strength of tube is lower than at ambient while cryogenic compressive strength of tube is better than at ambient. The thermal conductivities of unidirectional laminate and tube decreased with temperature decreasing.