INTERFACIAL FRACTURE PROPERTIES OF NOVEL CARBON FOAM SANDWICH STRUCTURES

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ABSTRACT

Novel sandwich structures based on high performance fiber reinforced thermoplastic skins bonded to a lightweight carbon foam core have been manufactured and tested. Here, carbon fiber reinforced polyetheretherketone (PEEK) skins were fusion bonded to a carbon foam core using a simple cold stamping manufacturing cycle. Single cantilever beam tests on pre-cracked samples indicated that an excellent level of adhesion can be achieved between the skin and core materials. In all specimens, the crack propagated within the carbon foam suggesting an additional in-situ evaluation of the fracture properties of the core material. To have a deeper understanding of the fracture toughness of the carbon foam, single edge notched bend (SENB) testing was performed. Results revealed that both test procedures yield similar values of fracture toughness. In this research project, the mechanical behavior of the multifunctional sandwich structures was also investigated using a state of the art non-contact strain measurement system. Local and global strain distributions close to the fracture path were revealed.

1. INTRODUCTION

Composite sandwich structures are widely used in air-craft, marine, space and other high technology industries. Sandwich constructions used in these applications, typically consist of a lightweight foam core bonded to thin face sheets to achieve excellent weight to strength and weight to stiffness ratios [1]. The main advantage of sandwich structures is their capability of providing increased flexural rigidity without considerable increase in their structural weight [2]. Sandwich structures consisting of composite facings and foam core material are believed to have an added value for primary aircraft structures by not only fulfilling mechanical, but also non mechanical functions such as thermal and acoustic insulation. In addition, applying the sandwich concept can result in part integration and weight savings, reducing both the manufacturing (assembly) and the operating costs of the structure [3].

Recently, there has been an increasing demand for advanced high-performance thermoplastics for composite structures. In fact, the carbon fiber reinforced thermoplastic composites which are polyetheretherketone (PEEK) based are able to offer great advantages for advanced structural components for applications in space and air-craft due to their high strength, stiffness, thermal and dimensional stability, etc [4]. PEEK is an injection and compression moldable polymer with a very good combination of thermal and mechanical properties along with resistance to harsh chemicals [5].For application where light weight, high stiffness, high thermal stability and excellent impact properties, PEEK is proving to be attractive [6].