The Polyimides Composites Processed by Resin Transfer Molding

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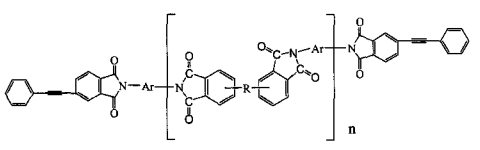
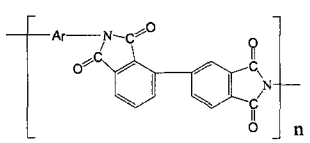
Abstract:

PMR-15 (PMR, in situ Polymerization of Monomer Reactants) polyimide composite is well known for its outstanding high temperature resistance, mechanical properties. The processing of PMR type composite is limited by compression or autoclave processing method, which are extremely low efficiency and high cost. Resin transfer molding (RTM) can reduce component fabrication costs by as much as 30-50% over compression or autoclave processing of prepreg materials. PETIs (Phenyl ethynyl terminated imides) resins based on 3,4'-BPDA have low viscosity and quite stability at 280 °C for more than 120 min, which could be processed by RTM techniques. The PETI-298, PETI-330 and PETI-375 for RTM were developed in NASA since 2000. The open hole compression (OHC) and short beam shear (SBS) properties were investigated. Other important properties, such as the mode I fracture toughness (G_{IC}) , the mode II fracture toughness (G_{IIC}) and compressive strength after impact (CAI) are seldom studied, which are very important data of aeronautical composites.

The thermosetting polyimide resin and the thermoplastic polyimide were synthesized in CIAC and the composite was fabricated in BIAM, the structure is shown on fig. 1 and fig. 2. The thermoplastic polyimide powder or film is used to tough the thermosetting polyimide composite. The properties of polyimide composites before and after *Ex*-situ toughening are showed on those tables at room temperature and 288 °C. The processing procedure of RTM composites is 280 °C/2h+300 °C/2h+330 °C/4h+371 °C/1h, while the elevated speed of temperature is 2-3 °C/min. The original composite is signed PI-9731, the *Ex*-situ toughened composite by polyimide powder is signed PI-9731(P), the *Ex*-situ toughened composite by polyimide film is signed PI-9731(F). From fig. 3, the flexural strength of the toughened composite is lower than the original composite both at room temperature, while the flexure strength of the toughened composite is the same as the original composite at 288 °C. The Interlaminar shear strength of toughened polyimide composite is higher than the original composite at room temperature as shown in fig. 3. From fig. 4-6, we can see the value of the toughened composites G_{IC}, G_{IIC} and CAI are increased very much compared to the original composite.



Scheme 1 Structure of thermosetting polyimide



Scheme 2 Structure of thermoplastic polyimide

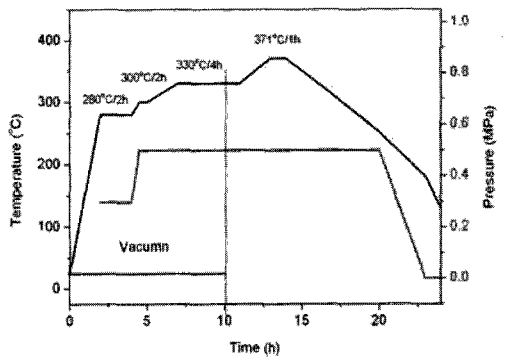


Fig. 1 Processing procedure of polyimides composites

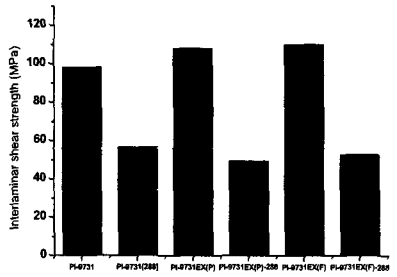


Fig. 2 Interlaminar shear strength of polyimides composites

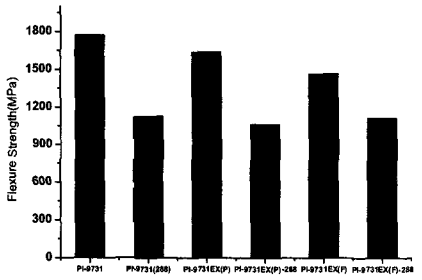


Fig.3 Flexual strength of polyimides composites

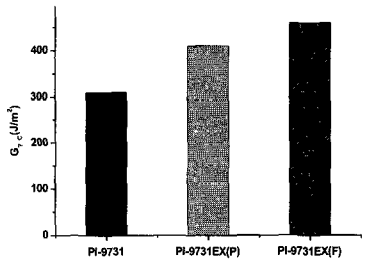


Fig. 4 G_{IC} of polyimides composites

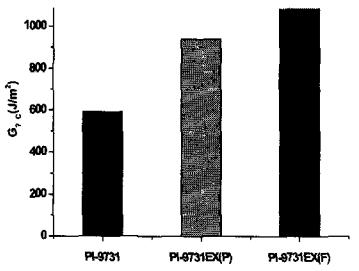


Fig. 5 G_{IIC} of polyimides composites

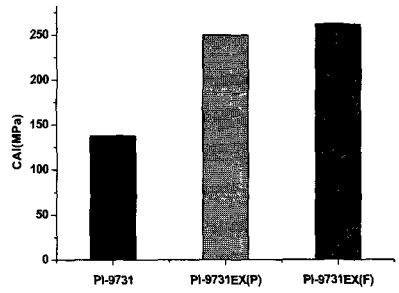


Fig. 6 CAI of polyimides composites

Acknowledgment:

The authors express their thanks to the National Science Foundation of China (NO. 10577018) and the National 973 Project of China (NO. G2003CB615604) for their financial support.

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