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Polymer Film Dewetting for Fabrication of Out-of-Autoclave Prepreg with High Through-Thickness

Permeability

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Abstract

Polymer film dewetting on a substrate (independent of fiber bed architecture) was explored, developed, and demonstrated as a method to produce out-of-autoclave, vacuum bag-only (OoA/VBO) prepregs with high transverse permeability and process robustness. The dimensions of the surface openings created by dewetting were measured, and the percent surface area exposed was calculated. Prepregs were fabricated with continuous and dewetted (discontinuous) films to produce trial laminates. The laminates were cured under both standard and sub-optimal conditions, and were characterized before, during, and after cure. Laminates fabricated with dewetted resin consistently achieved near-zero porosity. In contrast, laminates with continuous film displayed high levels of porosity, particularly during sub-optimal cure. The findings demonstrate that dewetting can be used effectively to produce OoA prepregs with high through-thickness permeability, which can yield porosity-free laminates via VBO processing. Furthermore, these results elucidate aspects of resin dewetting that are critical in the creation of robust OoA prepregs.

Key Words: A. Prepreg; A. Polymer-matrix composites; B. Porosity; E. Out of autoclave processing

1. Introduction

Aerospace manufacturers seek to reduce costs of traditional composites manufacturing methods by producing autoclave-quality composite structures using out-of-autoclave/vacuum bag-only (OoA/VBO) methods [1,2]. The desire to shift away from autoclave cure is motivated by high acquisition and operation costs of autoclaves, resource-intensiveness, and throughput limitations, which can constitute a production bottleneck. Currently, VBO prepreg processing can match the part quality of autoclave cure, but only in optimal situations, while sub-optimal manufacturing conditions lead to greater defect levels, particularly

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