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Preparation and Characterization of Novel Film Adhesives Based on Cyanate Ester Resin for Bonding Advanced Radome

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In this paper, the novel film adhesives based on phenolphthalein poly(ether sulfone) (PES-C) and epoxy (EP) modified cyanate ester resin (CE) were prepared for bonding an advanced radome. The film adhesives are convenient for applying to manufacture, possessing good adhesion strength, thermal durability and excellent dielectric property The curing behaviours were confirmed by differential scanning calorimetry (DSC), showing that the main reaction pathways are not varied with adding PES-C but the reaction rates are evidently accelerated, and the film adhesives can be well cured at lower temperature of 177 ℃. The adhesion strength was evaluated in lap shear strength and peel strength, indicating that the better adhesion strength is obtained with increasing in PES-C. The maximum value of lap shear strength is 33 MPa at room temperature. The thermal durability was determined by thermal aging tests of lap shear specimens, showing that the decrease in strength gets faster with adding PES-C, and the usability of film adhesives over 2000 h at 200 ℃. The dielectric properties were measured by dielectric resonator methods, finding that the introduction of PES-C brings a positive effect on dielectric properties. The lowest value of determined dielectric loss is 0.0075 at 10 GHz.

Key words: Cyanate ester, phenolphthalein poly (ether sulfone), dielectric, adhesion, thermal durability.

1. Introduction

In advanced aircraft radome field, the designed radome is aimed to protect the antenna from harsh service environments of aircraft [1]. Honeycomb sandwich structure is commonly used in an advanced radome configuration [2], where adhesive bonding is important to integrate composite skins and honeycomb into a coherent whole [3,4]. Hence, adhesives properties such as adhesion strength, thermal durability (＞200℃, long-term), and dielectric properties are also key to evaluate the usability of radome [5]. Epoxy resins (EP) have already dominated the field of structural adhesives in the last several years due to their excellent mechanical properties, commendable durability, high adhesion properties and good processes for most substrates [6,7]. However, the epoxy adhesives were not suitable for bonding the honeycomb sandwich structure of advanced aircraft radomes because of their poor thermal stability at 200℃and the deficient dielectric properties due to self-cross-linked structure.

Recently, cyanate ester resins (CE, T_g: 255-262℃) are used as an advanced material in aircraft and aerospace field due to their outstanding properties such as high temperature resistance, good dielectric properties, good mechanical and adhesion properties [8,9]. The excellent properties were attributed to their special crosslink triazine rings. However, like most highly cross-linked thermosetting resins, the CE resins tend to be brittle and have poor resistance to crack propagation. Hence, the cyanate ester resins are not fit for use as structural adhesives for bonding radomes before they are modified. Epoxy resins (EP) are usually used to modify CE resins for the matrix of high-performance com-