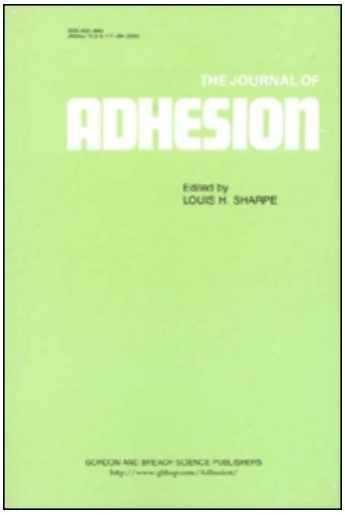

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Contents

Surface Molecular Mobility of Polyether Side Chains for Methylmethacrylate/ Methoxypolyethyleneglycolmethacrylate Copolymers

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(Accepted for publication: November 1, 1994)

Abstract

It is well known that a segment of multicomponent systems such as copolymers selectively adsorb and orient to the surface of the system so as to minimize interfacial free energy in response to a property of an environmental media. It is hypothesized that a side chain or graft chain would remarkably show these phenomena. Some copolymers composed of methoxypolyethyleneglycolmethacrylate (MPEGMA) and methylmethacrylate (MMA) were synthesized and measured dynamic contact angles (DCA) dipping into and out of water. An interesting behavior was found that the advancing contact angles in the second cycle of DCA measurements was larger than that of first cycle for these copolymers containing 30 ~ 70wt% of MPEGMA. It was shown via XPS measurements that surfaces of these copolymers cast from MEK were composed of MMA chains, methoxy groups and polyether chains, and relatively rich in MMA segments. We estimated that this behavior resulted in the adsorption and orientation of hydrophilic polyether segments in water and those of hydrophobic methoxy groups in air environmental media.

(Received: September 21, 1994)

Interfacial Debonding in Single Fibre Composites Preliminary Data from a Novel Approach

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(Accepted for publication: November 14, 1994)

Abstract

In order to study the fracture mechanics of the interface of composite materials, a limited number of theoretical models have been introduced to predict the energy absorbed by a propagating interfacial crack. The models have rarely been applied to experimental data due to the difficulty of measuring the crack growing during composite failure. With the use of single fibre models tests and a new UV cured urethane acrylate/quartz composite it is now possible to measure the debond growth with applied strain in single fibre specimens. Additionally, in order to study the influence of neighbouring fibres on the debonding process, for the ultimate translation of this data to full composite, tests may be carried out using two or more parallel neighbouring fibres. Preliminary experimental data along these lines are reported here.

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Evaluation of Interface Characteristics of Composites Based on Viscoelastic Properties

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(Accepted for publication: January 24, 1995)

Abstract

Interfacial characteristics of composites are examined on two types of glass fiber: one is coated with silica-gel particles, the other is not coated. These composites are made with the respective fiber cloth which are treated with or without silane coupling agents. The coefficients of a viscoelastic model for different

interfacial properties of composites are determined by the linear viscoelasticity theory. The coefficient values of a three element viscoelastic model are obtained from experimental short-term creep tests. Viscoelastic properties of composites are dependent on interfacial treatments. The coefficient values of the model show strong temperature dependencies, according to the different interface treatments. Degree in adhesion of interface can be estimated from measurements of viscoelastic properties. The silica-gel coated fiber exhibited the best adhesion against temperature increase. This suggests that the fiber surface relief is important to adhesion. The elastic deformation ratio between fiber and resin is estimated by the viscoelastic model. This ratio is equivalent to the transmissibility, and is significant to estimate interfacial adhesion bonding. This new approach to analysis of interfacial bonding has an advantage, as interfacial characteristics are measured non-destructively at any stress level.

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Measurement of Interlaminar Shear Strength of High Modulus CFRP and Its Failure Process by Double Notch Shear Test

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(Accepted for publication: February 10, 1995)

Abstract

The double notch shear (DNS) test method has been investigated as a means of measuring interfacial adhesion between high modulus carbon fiber and matrix resin. 90° tensile test or short beam shear test has been effective in measuring macro-interfacial adhesion for low modulus CFRP of, for example, 230 GPa. However, this is not the case for high modulus carbon fibers because fiber failure precedes interfacial failure in these methods due to low transverse and compressive strengths of the fibers. By shortening the length between notches, the double notch shear test could avoid fiber failure and caused interlaminar failure in high modulus CFRP. Different values of interlaminar shear strengths were obtained by changing the amount of fiber surface treatment. Also, the load-deflection curve became nonlinear before interlaminar failure, and yielding of matrix resin was associated with this nonlinearity.

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Acoustic Emission Analysis on Interfacial Fracture of Fabric Laminated Composites

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(Accepted for publication: February 16, 1995)

Abstract

An experimental approach has been discussed to characterize the interfacial failure progress in the overall failure generated in structural fabric composites. The structure failure of fiber reinforced composites is a complicated process consisting of several micro-failure mechanisms, such as fiber breaking, matrix cracking,

fiber/matrix debonding and delamination. Such micro-fractures caused numerous acoustic emission (AE) signals that can be detected. The approach, based on the AE technique, depends on the identification of AE source mechanisms. The source mechanisms can be discriminated by employing the rising-slope criteria (RSC) of AE signals. To describe the entire failure progress, the AE activity constitution ratios of a specific source mechanism to the overall activity are introduced. The analysis with the source mechanism constitution ratio can be successful to prove the influence of weave construction on fracture process for two kinds of plain-woven fabric laminates only with different weave construction but with the same surface-treatment on glass fiber. It is shown that dynamic monitoring of micro-failure mechanisms in composites is possible with an advanced AE analysis using RSC.

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Surface Analysis of Poly (ethyl acrylate)/poly (vinylidene fluoride-co-hexafluoro acetone) Blends by X-ray Photoelectron Spectroscopy

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(Accepted for publication: November 29, 1994)

Abstract

The surfaces of blends of poly (ethyl acrylate) (PEA) with poly (vinylidene fluoride-co-hexafluoro acetone) [P(VDF-HFA)] were investigated with X-ray photoelectron spectroscopy (XPS) at 15° and 90° take-off angles. In the PEA/P (VDF-HFA) blends, CF_3 and CF_2 peaks were observed at 295.3eV and 292.5eV, respectively, in the XPS spectra of C_{1S}. The atomic ratio of fluorine (F) to carbon (C), F/C, for PEA/P (VDF-HFA) blends is slightly increased with increasing P (VDF-HFA) contents from 10 to 50(wt%). The values of F/C at 15° take-off angle were larger than those at 90° take-off angle in these blends. It was suggested that the surface segregation of P (VDF-HFA) component should took place. In the PEA/P (VDF-HFA) blends, the F/C ratio was correlated with the critical surface tension γ_c. Finally, by surface tension γ calculated with state parameters, we explained why surface segregation could take place in these blends.

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Contents

Structure and Properties of Thermosetting Epoxy Adhesives Modified with Core/shell Acrylic Particles

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(Accepted for publication: October 24, 1994)

Abstract

Structure and properties of thermosetting epoxy adhesives modified with ion-crosslinked core/shell acrylic particles were investigated. These adhesives revealed excellent adhesion properties and semi-gelling property simultaneously. When the epoxy resin derived from ethylene oxide and bisphenol A was used as a reactive diluent in this system, the high adhesion strength and the high impact strength were obtained. This result is explained that introducing flexible epoxy resin caused the relaxation of internal stress of cured epoxy resin and toughened epoxy matrix.

(Received: September 26, 1994)

A Two-Dimensional Thermal Stress Analysis in Surface Mount Joint of Dissimilar Adherends in Different Temperatures and Subjected to Heat Radiation at Both Side Surfaces of the Bonds

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(Accepted for publication: December 19, 1994)

Abstract

This study deals with the thermal stress in a surface mount joint of dissimilar adherends under a steady state temperature distribution. Dissimilar adherends and an adhesive or a solder are replaced with finite strips in the analysis. Analytical approach is developed and general solutions for the thermal stress and the strain distributions in the joint are derived using a two-dimensional theory of elasticitry. The effects of the

ratio of the coefficient of thermal expansion, Young's modulus and the thickness of two dissimilar adherends to that of the adhesive on the thermal stress distributions are examined by numerical calculations. Moreover, it is shown that the thermal stress is singular at both the edges of the interfaces between adherends and a bonding material. In the experiments, the thermal stress distribution in an epoxide plate which was modeled as bonding material in a joint was measured by photoelasticity when the adherends were kept at different constant temperatures. From the comparison between the analytical and the experimental results, a fairly good agreement is shown.

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Effect of Solvent Concentration in Photoresist Film on Residual Strain and Adhesion

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Abstract

The effect of solvent concentration in photoresist thin film on residual strain and adhesion during development is studied. The solvent concentration is controlled by means of vacuum evaporation. The generation of residual strain is prevented as the solvent concentration increases; on the other hand, adhesion strength during pattern development decreases. The strain variation of resist film can be detected precisely by refractive index measurement. It is important to control the solvent concentration in terms of both the improvement of adhesion properties and the preventation of residual strain.

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Contents

Preparation and Evaluation of CFRP Honeycomb

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(Accepted for publication: January 26, 1995)

Abstract

Honeycomb core was tried to prepare by applying CFRP and the mechanical properties were evaluated. The strengths of CFRP honeycomb such as compressive and flexural ones increased largely with the density of honeycomb. This tendency is similar to other honeycombs such as aluminum one. The compressive and shear strengths of CFRP honeycomb were almost equal to those of aluminum one, when these strengths were evaluated as a function of density.

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Method for Determining Acid Drago Parameters of Metal Surface by IR-RAS Method

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(Accepted for publication: February 26, 1995)

Abstract

The infrared spectra of basic hexamethylphosphoric triamide and polymethyl methacrylate adsorbed on a steel surface were measured by the infrared reflection absorption spectrometry (IR-RAS) method. It was observed that absorbance peaks of the functional group of the compounds shifted to low wave numbers from their original state because of charge transfer bonds being produced between the compounds and the steel surface. The Drago's parameters of the steel surface were calculated using the energy shift, which has a correlation with the bonding enthalpy. The calculated parameters. 0.69 ± 0.3 for C and 6.3 ± 0.6 for E, were very similar to the parameters reported before for Fe_2O_3 particles in some literature.

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Effect of the Molecular Weight of Poly (L-lysine) for the Wettability Characteristics

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(Accepted for publication: December 28, 1994)

Abstract

The relationship between the degree of polymerization (DP) of poly (L-lysine) (PLL) and the surface wettability characteristics was investigated. Both the surface free energies and contact angles of the PLL

solutions decreased when the DP was increased from 2 to 32, these reached the minimum values at DP 32, and then increased up to DP 3260, and they also exhibited the concentration dependence. When we divided the surface free energies of the PLL peptides into the components, the dispersion components exhibited a constant value of about 26-28 mJ/m^2 but the polar components changed from 3 to 14 mJ/m^2. The total surface free energies were affected by the polar component of polypeptides. The conformation of the PLL peptides was analysed by circular dichroism spectroscopy.

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Correlation between Surface Force Measured by Atomic Force Microscopy (AFM) and Surface Free Energy Components of Thin Films

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(Accepted for publication: January 30, 1995)

Abstract

The micro cantilever mounted in atomic force microscopy (AFM) is adsorbed to thin film surfaces due to the surface force such as van der Waal's force. This surface force has positive correlation with the polar component of surface free energy measured by the contact angle method. However, it has no sensitivity to the dispersion component. By using AFM, the thermodynamic properties of thin film surface can be analyzed nondestructively in air.

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