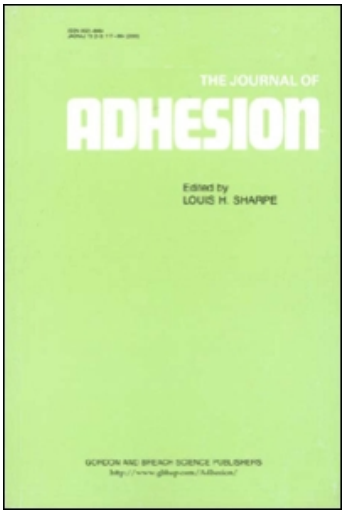

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Contents

Fracture Toughness and Strength of Epoxy Molding Compound Filled with Irregular-Shaped Silica Particles

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Abstract

Effects of the size of irregular-shaped silica filler particles on the fracture toughness and strength of epoxy molding compound as encapsulating material for integrated circuits was studied. The particles were prepared by crushing fused natural raw quartz and sorted into five groups having different mean sizes ranging from 5 to 47 μm. Critical stress intensity factor ($\mathbf{K}_{IC}$) and flexural strength (σ) of the cured epoxy molding compounds filled with these silica particles were measured. As the particle size increased,

K_{IC} value increased and σ value decreased. These results were discussed with scanning electron microscopic observation results of the fractured surfaces and crack tip regions.

(Received: December 17, 1991)

Surface Energy Analysis of Carbon Fiber and Its Contribution to Adhesion Strength between Carbon Fiber and Epoxy Resin

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Abstract

The surface energy analysis which was related to the adhesive strength between carbon fiber and matrix resin was investigated. The polarity and acidity of carbon fiber which were evaluated with surface energy were increased with increase in the surface oxygen content on the carbon fiber. The hysteresis of contact angle, which was caused by the reorientation or restructuring of the functional groups on the carbon fiber, increased with the rise in the polarity of liquids, but decreased with rise in the polarity of the carbon fiber. The functional groups introduced by oxidation treatment should be restrained from reorientation by localization of functional groups. This restraint of reorientation brought on the decrease in the hysteresis. The interfacial shear strength between carbon fiber and epoxy resin was correlated with the polarity and the acidity of carbon fiber calculated from advancing contact angles rather than from receding contact angles. It suggested that infiltration of resin into carbon fiber affected interfacial adhesion strength.

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Contents

Effect of the Electropolymerization on the Interfacial Shear Strength between the Carbon Fiber and Thermoplastic Matrix Resins

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Abstract

The surface characterization of carbon fiber and the interfacial shear strength between carbon fiber and thermoplastic matrices were investigated in order to evaluate ascendancy of electropolymerization onto carbon fiber. The electropolymerization brought on not only high surface oxygen and nitrogen content, but also high polar component of surface energy which was calculated from receding contact angles. However, the polar component of the electropolymerized carbon fiber which was calculated from advancing contact angles was lower than that of untreated or oxidized. It suggested that polar functional groups of the electropolymerized fiber were easy to reorientate or restructure.

The interfacial shear strength of electropolymerized fiber was larger than that of untreated or oxidized carbon fiber. But in the case of polyethersulfone as a matrix, electropolymerized fiber showed the same interfacial shear strength as oxidized fiber for the reason that the matrix resin yielded before the interface was exfoliated. The interfacial shear strength for untreated and electropolymerized carbon fiber increased with the increase in the differential thermal shrinkage of matrix and the friction coefficient which was calculated from surface energy. But interfacial shear strength of oxidized fiber was beside the point, because the friction coefficient of oxidized fiber calculated from surface energy was not equivalent to actual friction coefficient.

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Influence of Internal Layer of Substrate on PSA Properties

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Abstract

Pressure sensitive adhesives (PSA) are generally combined with the substrate in practical usage. In order to evaluate the practical properties of PSA tapes, we have to fix the specimens on a rigid plate usually by means of the other PSAs (double-faced PSAs). These double-faced PSAs including the substrate are only the internal layers which do not have a direct contact with the adherends in the test. They can have a significant influence upon the measured values concerning the PSA properties.

In this paper, we measured the rolling friction coefficient f and peel strength P of PSA tapes for the specimen where they are fixed on the glass by incorporating the internal PSA layers. We then compared the results with those obtained for the specimen where the respective PSAs are directly transferred on the glass.

It was found that f in the high velocity region increases greatly by incorporation of the internal PSA layer, provided that Tg of the layer is lower than that of the uppermost PSA. On the contrary, when Tg of the former is higher than that of the latter, no significant changes have been found in the f *vs.* log v curves. (It was also found that P *vs.* log v curves are not influenced greatly by the internal PSA layer.)

It has been pointed out that both bonding- and debonding- processes are involved in the rolling friction phenomena, and the former process is predominant at high velocity region.

In order to obtain the information on the features of the bonding process for the above mentioned specimens, we measured the probe tack values of the same samples, and determined the rate constant k, according to a simplified rate equations. Results show that the internal PSA layer of lower Tg gives higher k.

Therefore, we conclude that the increase of f in high velocity region is caused by improvement of the bonding process when Tg of the internal PSA layer is lower than that of the uppermost PSA, and that P *vs.* log v curves are not influenced greatly by the internal PSA layers, because the bonding-process must be well finished before the peel test.

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Contents

Studies on Barky Directional Strength of Weld Bonding Joint

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Abstract

The joint efficiency for Barky directional load and strength design method of adhesive/spot weld combined joint (weld bonding joint) was investigated by a Barky directional fatigue test and stress analysis by the finite element method of weld bonding joint, adhesive joint and spot weld joint, having three kinds of adhesive area.

An increase of Barky directional joint efficiency of the weld bonding joint was made clear, because a number of cycles to fracture of weld bonding joint was larger than the total number of cycles to fracture of the adhesive joint and spot weld joint, against the same load condition. The study of the connection of fatigue strength with stress distribution of weld bonding joint and adhesive joint revealed that the fatigue strength of these joints could nearly be estimated by the maximum stress of an adhesive layer analyzed by the finite element method, having no relation to the adhesive area.

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A Study on the Durability of Adhesive Joints for Bonding Car Body Panels

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Abstract

A study was made of a technique for predicting the service life of adhesively-bonded metal joints exposed to the strength degradation conditions of real-world use.

Attention was focused on the absorption of moisture by the adhesive joint as the main factor behind strength degradation. Analyses of the data obtained with a viscoelasticity measuring device, ultrasonic microscope and other analytical tools under a wet condition clarified the strength degradation due to moisture absorption.

A theory of adhesive strength degradation based on the diffusion coefficient of water was applied to the model to derive a formulation for predicting the service life of adhesive joints that suffer strength degradation due to moisture absorption. To confirm the validity of this formulation, it was used to calculate the strength of adhesive joints undergoing a weathering test in Okinawa. A comparison made with measured data showed good correlation between the calculated and experimental results. This confirmed that the formulation is a valid tool for predicting the static service life of adhesive joints.

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Vibration Damping Steel Sheets for Commercial Use in The Automobile

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Abstract

A thermosetting type polyester resin with three dimensional molecular structure crosslinked by an isocyanate hardening agent with three functional groups has been newly developed for a viscoelastic resin of vibration damping steel sheets for room temperature use. A vibration damping steel sheet, made by laminating two steel sheets with this new viscoelastic resin and Ni powder, has superior series-spot weldability with no defect such as sparking and ringed-cut-off. Various damping steel sheets composed of coldrolled steel sheet and galvanized steel sheet are of wide application under optimum condition of the amount and hardness of Ni powder and the ratio of Ni powder average diameter to resin thickness. Newly developed vibration damping steel sheets have the same spot weldability, formability, baking durability and anti-corrosion as a steel sheet for commercial use in various industries, such as automobile, on account of their superior damping capability and a great demand for quietness.

Vibration damping steel sheets with viscoelastic resins of higher glass transition temperature than room temperature can be used for automobile accessories for moderate and high temperature use.

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