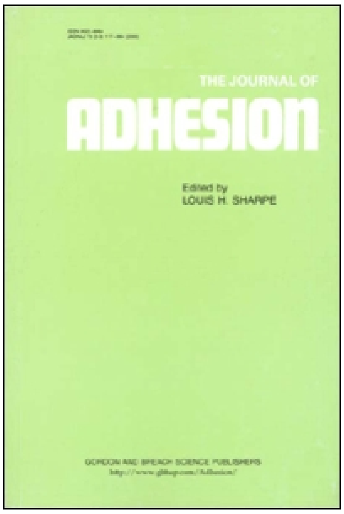

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Contents Lists and Abstracts from the Journal of the Adhesion Society of Japan

Journal of The Adhesion Society of Japan
Vol. 30 No. 2 1994

Contents

Original

Technical Report

Review

A Study of Strength Distribution for Adhesive-Bonded Joints

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(Accepted for publication: June 4, 1993)

Abstract

In this paper, the author will make a statistical analyses of the strength of adhesive-bonded specimens, bonded with certain kinds of adhesives. Five different distributions (normal distribution, largest value extreme distribution, smallest value extreme distribution. Weibull distribution, and beta distribution) are applied to consider this problem. The suitability of these five types of distribution is estimated by RMRSS (Roule mean Residual Sum of Squares), AIC- Akaike's Information Criterion Statistic-and χ^2 value. The strength distribution of adhesive-bonded specimens could not be expressed with fixed distribution; however, it depends on the adhesive and the base metal. These results indicate the importance of knowing the strength distribution for the appropriate reliability evaluation.

(Received: May 7, 1993)

Mechanical and Vibration Damping Properties of Adhesive Bonded FRP Joints with High Toughness Adhesion

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(Accepted for publication: August 2, 1993)

Abstract

In this study, we fabricated adhesive bonded GFRP joints with high toughness epoxy resin by modifying conventional epoxy resin. The effects of high toughness adhesives on mechanical properties and on vibration damping (one of the functional properties) were discussed.

Joint shear strength with toughness adhesive was nearly equal to conventional bonded joint strength. However, failures of joint region with high toughness adhesive bonded joints occurred on a smoother surface then they did with conventional adhesive bonded joints. Due to using high toughness adhesive, delamination in adherends did not occur. Furthermore, vibration damping properties of toughness adhesive bonded joints were about twice as effective as those of conventional adhesive bonded joints. Therefore, in improving the toughness of an adhesive. We found it to be effective for insuring both high mechanical properties and high damping properties.

(Received: May 6, 1993)

Creep Rupture of Ultrasonic Welding for Plastic Materials Using Various Solutions

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(Accepted for publication: June 4, 1993)

Abstract

The purpose of this article is to investigate the effects of creep rupture, a characteristic of ultrasonic welding for POM and ABS resin when using silicone oil or water. The solutions used in the creep rupture tests were silicone oil and water. The test temperatures ranged from 20 to 100 °C.

The results obtained are as follows:

1) When subjected to ultrasonic welding using solutions of oil or water with POM and ABS resin, the effects of creep rupture are worse than when using the plastic materials by themselves. Also, when a solution is used. it was found that the effects of creep rupture were worse with water than with silicone oil.

2) The empirical formula for calculating the extent of creep rupture both for ultrasonic welding of POM and ABS resin with solutions and without solutions, as shown in previous papers,[1] [3] is given by,

$$\sigma_c = (\sigma_{coo} - n_1 \tau) - (m_{co} - n_2 \tau) \log (t_c/t_o)$$

where σ_c is extent of creep rupture at t_c hr; σ_{coo} is the extent of creep rupture 0 °C at rupture time of t_o(1 hr) loading; m_{co} is the amount of stress change par $\log_{10}$ $(10 t_c - 1 t_c)$; n_1 and n_2 are constants; τ is the temperature (°C). The value of n_1 ranges from 1.50 to 9.00. and n_2 ranges from $-$0.35 to 0.45.

3) Concerning the creep rupture effects of POM and ABS resin by themselves, Larson-Miller's coefficient formula is applicable to ultrasonic welding for POM and ABS resin within the following temperature ranges:

a) POM	−20 to 80
b) ABS resin	−20 to 60.

1) H. Ishii, Y. Yamaguchi; Journal of The Adhesion Society of Japan, **15**, 7, 1 (1979)
2) H. Ishii, E. Matumura, Y. Yamaguchi; Journal of The Adhesion Society of Japan, **23**, 1, 13 (1987)
3) H. Ishii; Journal of The Adhesion Society of Japan, **29**, 7, 316 (1993)

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Journal of The Adhesion Society of Japan
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Contents

Original

Technical Report

Review

Study on Application of Long Chain Dibasic Acid to Adhesives

II. Epoxy Adhesives with Polyamide Hardeners Synthesized with Long Chain Dibasic Acid and various Diamines

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(Accepted for publication: February 1, 1993)

Abstract

The polyamides were synthesized with various diamines and long chain dibasic acid (ULB-20M) obtained by ring opening dimerization of 1-methoxy-1-cyclohexylhydroperoxide in the presence of 1,3-butadiene. The polyamides were used as hardners of epoxy resin adhesives, and the tensile shear strength and T peel strength of Fe/Fe joints were measured. The effects of diamine components and molecular weight of the polyamide on the bond strength were studied. The results showed that the higher the molecular weight to polyamide, the higher the peel strength and tensile shear strength were.

(Received: January 7, 1993)

Adhesive Properties and Cured Resin Properties of Urethane Elastomer-Modified Epoxy Resin Having Hydroxymethyl Group

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(Accepted for publication: September 20, 1993)

Abstract

Adhesive properties and cured resin properties of urethane elastomer-modified epoxy resins were studied. The urethane elastomer-modified epoxy resins were synthesized by the reaction of *p*-cresol type epoxy compound having hydroxymethyl group (EPCDA) with isocyanate prepolymer. These epoxy resins (EPCDATDI) were mixed with a commercial epoxy resin (DGEBA) in various ratios. The mixed epoxy resins were cured with triethyleneglycoldiamine as a hardener. In the viscoelastic properties of the cured resins, the α'- and β-relaxation peaks in $\tan\delta$ curves for the modified epoxy resins, which is based on the motion of EPCDATDI and urethane elastomer, respectively, appeared. The higher the molecular weight and the concentration of EPCDATDI, the smaller the storage modulus and the larger the magnitude of α'- and β-relaxation peaks in $\tan\delta$ curves were, while the glass transition temperature was the same as that of unmodified epoxy resin. The addition of less than 20 wt.% of EPCDATDI improved the toughness of cured epoxy resin. Fracture surfaces of the cured epoxy resins modified with less than 20 wt.% of EPCDATDI were observed, wherein the microphase separated structure consisted of small elastomer particles dispersed in the epoxy matrix. It was hypothesized that the microphase separated structure played an important role in toughening the epoxy resin. Tensile shear strength and peel strength of adhesives were improved by the addition of EPCDATDI to a commercial epoxy resin. These results are

explained by the following: introducing hydroxymethyl group, urethane linkage, and the phase separated structure of cured epoxy resin, caused the adhesion force to improve between cured epoxy resin and the steel surface; also, introducing urethane elastomer caused the relaxation of internal stress of cured epoxy resin adhesive.

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Contents

Synthesis and Surface Properties of Silicone-MMA Graft·Block Copolymers

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(Accepted for publication: January 13, 1994)

Abstract

The surface properties of silicone polymers are controlled not only by their polysiloxane content but also by polysiloxane chain length. In this work, silicone macromonomer-methyl methacrylate graft·block copolymers were prepared by two-step polymerization method using a poly-azo-initiator, poly (1,6-hexamethylene azobiscyanopentanoate), to study that effect of block copolymer structure on their surface properties. It was found from water contact angle, ESCA, and attenuated total reflectance FTIR studies that polysiloxane chains even with a relatively low molecular weight, i.e., 1000, were segregated particular-

ly on the air side surfaces of the cast films. This polysiloxane segregation in their graft·block copolymers was proved by 180° peel strength measurement.

(Received: October 29, 1993)

Improvement of Gas Barrier Property of Polyolefin Moldings. I.

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(Accepted for publication: January 13, 1994)

Abstract

For improvement of the gas barrier property of polyolefine films, seats and vessels etc., an industrially effective coating method was examined.

Vinyl monomers and diacrylated oligomers were mixed, and a photo·initiator was added. The mixtures were spread onto polyolefin moldings and cured with UV light.

Gas barrier and other physical properties of the coatings obtained which consisted of crosslinked polymers, were studied.

As a result, coating polyolefin moldings with good gas barrier properties were prepared.

(Received: October 16, 1993)

Effect of Functional Groups on Adhesive Strength of Coating Film for Polypropylene Sheet

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(Accepted for publication: December 10, 1993)

Abstract

The surface of a polypropylene (PP) sheet was treated with microwave plasma, which was generated by an electric oven. Acrylate-methacrylate coating materials, having various components, were spread on to the surface of the treated PP sheet. The adhesive strength and the fraction amount of coating per one cm^2, which remained on the surface of PP sheet, were measured by using a cross-cut tape test. We found that the existence of butyl acrylate in the coating was a very important adhesion element in this system. The relationship between the adhesive strength and the functional groups on the surface of the PP sheet was determined quantitatively by multiple regression analysis.

(Received: September 27, 1993)

Surface Modification of Poly (Ethylene Terephthalate) with Ion Implantation

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(Accepted for publication: March 28, 1994)

Abstract

The surface modification of poly (ethylene terephthalate) was carried out by an ion implantation with various ions (nitrogen, fluorine, oxygen, silver), and the contact angle, friction coefficient, plateability of implanted surface and electric resistance of implanted layer were investigated. The implantations were performed with $50 \sim 200\,\mathrm{keV}$ ions at fluences ranging from $1 \times 10^{13} \sim 1 \times 10^{17}$ ions/cm^2. Implanted layers discolored to black and carbonizated with increasing fluence. The contact angle increased with increasing fluences and these surfaces were hydrophobic. Implanted silver ion was existed with the Gauss distribution in fixed depth, but implanted nitrogen, oxygen and fluorine ions almost did not exist in implanted layer. The friction coefficient decreased with increasing fluences. Moreover, the adhesion and plateability of implanted surface were not improved due to carbonization of surface and absent of implantated ions in surface. The conductivity increased with increasing fluences.

(Received: January 14, 1994)

Effect of Ion Species and Dose on Surface Properties and Adhesion of Ion-Irradiated Polytetrafluoroethylene

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(Accepted for publication: December 1, 1993)

Abstract

Polytetrafluoroethylene (PTFE) sheets were irradiated with 10–30 keV nitrogen, xenon, titanium and tin ions in the dose range of 10^{13}–10^{17} ions/cm^2. SEM revealed rough, grass-like featured surfaces developing with the mass and dose of the ions. The presence of some oxygen-containing polar groups was confirmed by XPS and IR in all irradiated samples. The surface crystallinity evaluated by DSC was reduced with every ion except for nitrogen. The friction test showed a low friction and a hard or brittle character of the surfaces modified with xenon ion, while there was higher friction with the other ions. Peel strengths of the irradiated PTFE strips bonded with epoxy adhesives increased with an increase in the mass and the dose ($5 \times 10^{15} - 5 \times 10^{16}$ ions/cm^2 at 30keV) for nitrogen, titanium and tin ions, but those for xenon ion were low and less dose-dependent. This poor adhesion property of xenon ion-irradiated samples was considered to be mainly attributed to the brittleness in their surface layers.

(Received: November 1, 1993)

Surface Modification of High Performance Polyethylene Fiber (EF) by Photo-oxygenation and Characteristic Changes of EFRP Made with Modified EF

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(Accepted for publication: January 18, 1994)

Abstract

Surface modification treatment of high performance polyethylene fiber (EF), which is one of the organic reinforcing fibers for composites, and the influence of modified EF on several properties of EFRP (made with epoxy resin) were studied. Photo-oxygenation treatment as a dry method, which utilizes a synergistic effect of ultraviolet irradiation and an oxygen gas containing ozone at atmospheric pressure, was applied to modify the surface of EF. Characteristic changes of modified EF and EFRP were examined through XPS (X-ray photo-electron spectroscopy) analysis, SEM (Scanning electron microscope) observation, DSC (Differential scanning calorimetry) analysis, and color and dynamic viscoelastic measurement.

The results are as follows: (1) Ether bond is mainly introduced into the surface of modified EF by photo-oxygenation; (2) Thermal properties in epoxy curing reaction, color and dynamic viscoelastic properties of EFRP made with modified EF differ from those of the EFRP with non-treated EF; (3) Curing degree of matrix resin is able to be changed by controlling the functional group through surface treatment.

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