

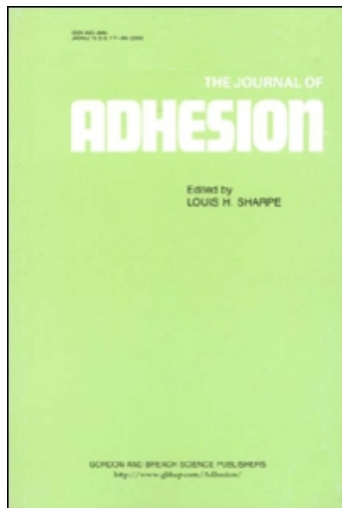
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The Journal of Adhesion

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713453635>

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

To cite this Article (2000) 'Contents Lists and Abstracts from the Journal of the Adhesion Society of Japan', *The Journal of Adhesion*, 72: 1, 105 – 114

To link to this Article: DOI: 10.1080/00218460008029272

URL: <http://dx.doi.org/10.1080/00218460008029272>

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

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Viscoelastic Properties of Thermosetting Resin During Curing Under Variable Temperatures

HIROKI NIUCHI^a, CHIAKI SATO^b and KOZO IKEGAMI^b

^aGraduate School of Tokyo Institute of Technology, 4259 Nagatsuta, Midoriku, Yokohama;

^bTokyo Institute of Technology, Precision & Intelligence Laboratory, 4259 Nagatsuta, Midoriku, Yokohama

(Accepted for publication 1 June 1998)

Viscoelastic properties during curing were measured experimentally by a rheometer of rotating double cylinders. The viscoelastic constitutive relations during curing were formulated by a spring-dashpot model of three elements. The viscoelastic parameters during curing under variable temperatures were estimated by the viscoelastic parameters determined under various constant temperatures. The estimated parameters fitted approximately to the experimentally determined parameters under variable temperatures.

(Received 7 August 1998)

Adhesion of Paint on Aluminum Treated with Phosphate Primer

TOSHIO OGAWA, JIN YASUDA and SATOSHI OSAWA

*Laboratory for Materials Design Engineering,
Kanazawa Institute of Technology 7-1 Ohgigaok, Nonoichi,
Ishikawa 921-8501, Japan*

(Accepted for publication 12 October 1998)

Adhesive properties of aluminum were improved by use of phosphoric acid type primer. Adhesive properties between aluminum-magnesium alloy (5000 series) and paint were studied. The adhesive strength was improved considerably by use of the primer containing phosphoric acid, zinc chromate and polyvinyl butyral. Cohesive failure occurred in the peel test of water soluble paint. This fact was proved by ESCA analysis of peeled surface. The correlation between adhesive strength and primer components was surveyed in detail. It was found that phosphoric acid contributes most effectively to the adhesive strength.

(Received 10 August 1998)

Vibrational Spectroscopic Studies on Wood and Wood-Based Materials (IV) Solvent Effects of Diluent on MDI Penetration Behavior in Wood

SHIGERU YAMAUCHI, YASUO TAMURA,
YASUJI KURIMOTO and AKIO KOIZUMI

*Institute of Wood Technology, Akita Prefectural University,
Kaieisaka, Noshiro, 016 0876 Japan*

(Accepted for publication 21 October 1998)

Infrared diffuse reflectance and Raman spectra of air-dry sugi blocks impregnated with crude MDI were measured. Antisymmetric NCO stretching (2270 cm^{-1}) and a polarized band at 1530 cm^{-1} were adopted as an indicator of MDI in the wood in the infrared and the Raman spectra, respectively. The solvent effects of acetone or benzene, which is diluent, on penetration behavior of MDI in air dry sugi wood were investigated on the

basis of the vibrational spectral data. As a result, it was indicated that MDI-acetone solution penetrates into wood cell wall more easily than MDI-benzene solution. The two dimensional analytical data by infrared spectroscopy demonstrated that residual air and pit closure between tracheids are one of the most interfering factors of longitudinal penetration in sapwood and in heartwood, respectively.

(Received 14 September 1998)

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Adhesion Properties of Low Density Polyethylene Film Treated by Carbon Dioxide Plasma

TOSHIO OGAWA, TOMOYUKI SATOU and SATOSHI OSAWA

Laboratory for Material Design Engineering, Kanazawa Institute of Technology 7-1, Ohgigaoka, Nonoich, Ishikawa 921-8501 Japan

(Accepted for publication 22 September 1998)

A low density polyethylene (LDPE) sheet was treated by a carbon dioxide plasma to improve adhesive properties. This treatment was found to occur uniformly over the surface of the LDPE sheet.

Water soluble materials were produced on the LDPE sheet surface upon treatment of the carbon dioxide plasma. However, these materials advantageously contributed to adhesion. Optimum conditions on the adhesion and the plasma treatment were present for the lamination of the LDPE with polyethylene-terephthalate (PET).

(Received 10 August 1998)

“The Triangle of the Work of Adhesion” and the Dupre-Gamo Equation (Provisional Name)

HIROSHI TOMINAGA, TOMOMI ISHIBUCHI* and MASAHARU OHMI

Faculty of Agriculture, Tokyo University of Agriculture and Technology, Fuchu-shi, Tokyo 183-8509, Japan

(Accepted for publication 6 November 1998)

“The triangle of the work of adhesion” was found out from the calculus of the surface free energy. The triangle was the right-angled triangle with the contact angle θ , and that the three equations of the work of adhesion $W_G = \sigma_L(1 + 1/\cos \theta)$, $W_Y = \sigma_L(1 + \cos \theta)$

*Present address: Onahama Plywood Co. Ltd., Iwaki-shi, Fukushima 971-8183, Japan.

and $W_G = \sigma_L \sin \theta(1 + 1/\cos \theta)$ corresponded to the hypotenuse of the triangle with the angle θ , the bottom side with the angle θ and the opposite side to the angle θ respectively (σ_L , surface tension of liquid; θ , contact angle of droplet on solid surface). And the Dupre-Gamo equation W_G was verified using the specific work of adhesion W_G/σ_L and the theoretical curve $|1 + 1/\cos \theta|$. All results on the specific work of adhesion were plotted into the figure with the theoretical curve, and coincided well with the theoretical curve.

(Received 21 September 1998)

Three-dimensional Finite Element Analysis of Stress Response in Adhesive Single-lap Joints Subjected to Impact Bending Moments

IZUMI HIGUCHI^a, TOSHIYUKI SAWA^b and HIDEKAZU SUGA^c

^a*Kofu Jyosai High School 1-9-1, Shimoiiida Kofu 400-0064, Japan;*

^b*Department of Mechanical Engineering, Yamanashi University
4-3-11, Takeda, Kofu 400-0016, Japan;*

^c*NKK Co., Fukuyama, Japan*

(Accepted for publication 27 January 1999)

The stress wave propagation and the stress distribution in adhesive single-lap joints of similar adherends subjected to impact bending moments are analyzed in an elastic deformation using three-dimensional finite-element method (FEM). An impact load is applied to a joint by dropping a weight. Three-point impact bending moment is applied to the joint. FEM code employed is DYNA3D. The effects of Young's modulus of the adherends, the lap length, the adherends thickness and the adhesive thickness on the stress wave propagation at the interfaces are examined. It is found that the maximum value of the maximum principal stress σ_1 appears at the the interface of the upper adherend subjected to impact bending moments. The maximum stress increases as Young's modulus of adherends, the lap length and the adhered thickness increase. The maximum stress increases with decreasing adhesive layer thickness. In addition, experiments were carried out to measure the strain response of single-lap joints subjected to impact bending loadings using strain gauges. Fairly good agreement is seen between the analytical and experimental results.

(Received 24 September 1998)

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Effect of Crosslinked Urethane Microspheres Made by Dynamic Vulcanization Method on the Toughness and Adhesion Properties of the Cured Epoxy Resin

TAKAHIRO OKAMATSU^a, HAJIME YUYAMA^a,
YUKO MAEDA^a, HIDEAKI HANAZAWA^b
and MITSUKAZU OCHI^c

^a*Nippon NSC R & D. Corporate Research 1st Project;*

^b*Nippon NSC R & D Division 1-6-5, Senba nishi, Mino shi.
Osaka, 562-8586, Japan;*

^c*Department of Applied Chemistry, Faculty of Engineering,
Kansai University, 3-3-35, Yamate-cho. Suita-shi, Osaka 564-8680*

(Accepted for publication 25 December 1998)

In order to give a toughness and an improved adhesion properties to cured epoxy system, modified epoxy resins containing crosslinked urethane microspheres, which were formed by using a dynamic vulcanization method in liquid diglycidylether of bisphenol A, were prepared. It was found that the size of the particles dispersed in the epoxy matrix decreased to sub-micro order with increasing in solubility of the oligomers into the epoxy resin, and particle size coefficient of variance resulted in less than 15%. Lap shear strength, peel strengths and fracture energy G_I of the cured system were improved by modification with the crosslinked microspheres, and the adhesion properties of the modified system did not depend on any curing conditions because of the formation of stable particles in the epoxy resin before curing.

(Received 15 October 1998)

Development and Performance Evaluation of High-Resolution Tester of Shear Adhesion for Pressure-Sensitive Adhesives

ZENICHI MIYAGI and MASAYOSHI KOIKE

*National Research Laboratory of Metrology, 1-1-4 Umezono,
Tsukuba, Ibaraki, 305-8563, Japan*

(Accepted for publication 7 December 1998)

A new shear adhesion testing apparatus for pressure sensitive adhesives (PSA) has been developed, by which the slippage of PSA under shearing load can be measured with the resolution of $0.02 \mu\text{m}$ per digit. The temperature of the surface of adherend can be changed from 0 to 100°C by a thermo-module using the Peltier effect. The specimen is attached to the adherend made of stainless steel plate in the way prescribed by JIS. Shearing load is applied by a dead weight. A quartz glass block is put on the specimen, and the micro slippage of the specimen is measured using a laser displacement sensor. The uncertainty of the new testing method was estimated to clarify the performance of the testing method with standard uncertainty, and an expanded uncertainty was $0.78 \mu\text{m}$ ($k = 2$) at the measurement displacement of $300 \mu\text{m}$. In experiments using this apparatus, the slippage of an acrylic PSA for liquid crystal panels was measured at 9.8 N shearing load. The aggregate slippage of specimen increases as the surface temperature of adherend increases. The results using the developed apparatus agree with the prediction based on viscoelastic considerations.

(Received 26 October 1998)

Hydrophobic Treatment of Polymer Surface Through Fluorine and Alcohol Mixed Plasma

TAKASHI NISHINO, HIDEKI TSUCHIDA,
YUTAKA ISU and KATSUHIKO NAKAMAE

*Department of Chemical Science and Engineering, Faculty
of Engineering, Kobe University Rokko, Nada, Kobe 657-8501, Japan*

(Accepted for publication 13 January 1999)

Tetrafluoromethane plasma was irradiated on the surface of high density polyethylene (HDPE). The dynamic contact angle increased from 88° to 114° by plasma treatment for 5 min. This corresponds to the surface free energy of 14 mJ/cm^2 , which is lower than that (22 mJ/cm^2) of polytetrafluoroethylene. However, longer plasma treatment brought the decrement of the dynamic contact angle, and the surface free energy apparently increased. The mixed plasma of tetrafluoroethane with a small amount of methanol was found to be quite effective to maintain the high contact angle even at longer irradiation time. This mixing effect is due to the suppression of the surface roughness through etching, judging from the X-ray photoelectron spectra and scanning electron micrographs. Same effects were also observed by adding ethanol and *n* propanol to tetrafluoroethane plasma.

(Received 15 December 1998)