Interphases & Interfaces

Micromechanial Deformations in Particulate Filled Polymers: The Effect of Adhesion
K Renner, J Móczó, B Pukánszky (Budapest Univ of Technology & Economics)
Debonding is the dominating micromechanical deformation mode in particulate filled polymers, which depends on interfacial adhesion. PP composites were prepared with different fillers having a wide range of properties and debonding was studied by acoustic emission to determine the mechanism of the debonding process and the effect of interfacial interaction on it. (D7:1)

Characterisation of Interfaces in Micro- and Nano-Composites
TJ Young, M Monclus, WR Broughton (NPL) SL Ogin, PA Smith (Univ of Surrey)
This paper details a quality control test for polymeric composite interfaces independent of reinforcement type and geometry. Experimentation has shown the capability of AFM indentation in characterising interfacial mechanical property variation with focus on measurement quantification to produce elastic modulus maps at the micro- and nano-scale. (D7:2)

Structural Dynamics and Interfacial Properties of Elastomer Nano-Composites
M Klueppel, J Fritzsche (DIK)
The combined effect of filler networking and reduced chain mobility close to the filler interface on the dynamic-mechanical properties of elastomers is analyzed based on investigations of the relaxation dynamics of solution styrene butadiene rubber filled with different loadings of silica. Dynamic-mechanical and dielectric spectra are studied in a wide frequency and temperature range. (D7:3)

Experimental - Analytical and Numerical Investigation of Interphasial Stress and Strain Fields in MWCNT Polymer Composites
GC Papanicolaou, VD Drakopoulos, KP Papaefthymiou (Univ of Patras)
In the present investigation, the effect of polymer matrix-nanofiber interphase on the stress and strain fields developed in the close vicinity of MWCNT was studied. The recently developed concept of the hybrid interphase was applied. According to this concept, the interphase concept depends on the property considered at the time. Experimental findings combined with analytical and numerical results gave a better understanding on the structural and mechanical performance of epoxy resin-carbon nanotubes composites performance. (D7:4)

Molecular Dynamics Simulation of Cohesive Failure In Glass/Epoxy Interfaces
VBC Tan, M Deng, TE Tay (National Univ of Singapore)
The construction of force fields for Coarse Grained Molecular Dynamics simulations directly from ab initio calculations is presented in this paper. The force fields are then applied in the modeling of a glass-epoxy interface comprising an extensively cross-linked epoxy system and a silane to study its mechanical response to tensile loads. (D7:5)

Development and Application of Microbond Test for Characterizing Fiber-Matrix Adhesion
T Czigany, B Morlin (Budapest Univ of Technology and Economics)
Interfacial adhesion has been studied between glass fiber and polymer matrices, by using a microbond test. In order to reproduce the measurements the method has been developed further. To provide more favourable test conditions the samples have been modified. Suitable equipment has been devised and built to perform the test. (D7:5A)
UD Composite in Mechanical Fatigue: Modelling Multiple Fiber Breaks and Debond Growth
A Pupurs, J Varna (Lulea Univ of Technology)
When unidirectional fiber reinforced polymer composites are loaded in tension-tension fatigue multiple fiber breaks occur in random positions during the first cycle. Assuming that fibers do not experience fatigue, the further damage evolution with increasing number of cycles is in form of debonds growing along the fiber/matrix interface. Fracture mechanics analysis is performed to compare this mechanism with an alternative one where debonds initiate from transverse matrix cracks. (D7:6)

A Numerical Study on Idealised Interphase Properties
AR Maligno*, NA Warrior, AC Long (Univ of Nottingham) *(& Sheffield Hallam Univ)
A numerical study has been performed to investigate local damage in composite materials under transverse loading. The effect of different interphases and thermal residual stresses has been considered. Results indicate a strong dependence on damage onset and its evolution from the interphase properties and the presence of residual stress. (D7:7)

Local Failure Processes in Fiber Reinforced Polymers
C Marotzke, G Kalinka (BAM)
Different elementary failure processes such as fiber break, matrix and interface crack are investigated on model experiments using acoustic emission analysis Three types of experiments are performed, governed by different failure processes. The experimental results are compared with finite element calculations of the released energy. (D7:8)

Interfacial Properties of Glass Fibre/Nanoparticulate Reinforced Polyester Resin
AR Wood, JF Watts, PA Smith (Univ of Surrey) E Mäder, S-L Gao (Leibniz Institute of Polymer Research Dresden) FR Jones, Z Liu (Univ of Sheffield)
The single fibre pull-out (SFPO) test and the single fibre fragmentation test (SFFT) have been utilised to determine the interfacial properties of a glass fibre and two resin materials; i) polyester resin ii) an ormosil nanomodified polyester resin material. Both analysis techniques provided similar trends in the test data. (D7:9)

Atmospheric Plasma Treated VGCF/PP Nanocomposites by Melt-Mixing Process
BS Kim, NQ Khuyen, JH Byun (Korea Institute of Materials Science) S Lee (Changwon National Univ)
The raw vapor grown carbon fibers (VGCF) and atmospheric plasma treated (APT) VGCF/PP were fabricated by the melt-mixing process, respectively. The effect of atmospheric plasma treatments on the mechanical properties of VGCF/PP was investigated. The tensile modulus and strength of APT VGCF/PP showed higher value than those of raw VGCF/PP. (D7:9A)

Evaluation of Glass Fiber/Epoxy Interfacial Strength by the Cruciform Specimen Method
J Koyanagi (JAXA) H Kato, A Kashima, Y Igarashi, I Ueno, S Ogihara (Tokyo Univ of Science) K Watanabe (Mitsubishi Rayon Co Ltd)
The interfacial strength in a glass fiber/epoxy composite is evaluated by using the cruciform specimen method. The direction of the fiber and the loading direction of the cruciform specimen are changed. The relation between the interfacial tensile stress and the interfacial shear stress is examined experimentally and analytically. (D7:11)
Characterization of the Interphase Width in Carbon Fibre Reinforced Epoxy Resin Composites
M Li, J Wang, Z Zhang, Y Gu (Beihang Univ)
This study focused on the characterization of interphase region in carbon fibre reinforced epoxy composites conducted by a newly developed modulus mapping test. Based on the modulus map, a non-uniform interphase region can be analyzed, as well as the local modulus gradient. Furthermore, the width of interphase can be obtained from 80nm to 270nm in different carbon fibre/epoxy systems. (D7:12)

Effect of Silane Coupling Agents on Filling of Magnetic Particles in Resin Composites
N Ikuta, Y Awakura*, R Matsui, T Tsukano, F Funami (NEC Tokin) *(also at Shonan Institute of Technology)
Noise suppression sheet contains magnetic filler and thermoplastic resin. High filling of the filler is known to raise the ability of noise suppression. In the study, silane treatment of the filler has been tried to improve the rate of the filling. Among various kinds of silane, cationic amino silane has given the highest filling. (D7:13)

Micro-Thermal, X-ray and Raman Analyses of Polyolefin Interfaces
T Nishino, M Kotera, D Izumo, Y Urushihara (Kobe Univ)
Polyolefin laminate interface was analyzed using scanning thermal microscopy (space resolution: ca. 1.5 micrometer), synchrotron micro X-ray diffraction (900 nm) and micro-Raman scattering (300 nm). For linear-low density polyethylene / deuterated polyethylene laminate, the thickness of the interface was evaluated as several micrometer, which increased by annealing. The adhesive strength also increased by annealing, correspondingly. (D7:14)

Effect of Silane Sizing on Polymer-Glass Adhesion
H Dvir, M Gottlieb (Ben Gurion Univ)
Several types of common polymers were deposited on glass slides sililated with organofunctional silanes. The extent of surface coverage, adsorbed layer thickness and topology were experimentally determined. The strength of polymer interaction with the silane treated glass was investigated using contact-mode AFM. (D7:15)

Novel Carbon Fiber Surface Treatment with Ultraviolet Light in Ozone to Promote Composite Mechanical Properties
MJ Rich, LT Drzal, BP Rook, P Askeland, EK Drown (Michigan State Univ)
A novel technique employing ultraviolet (UV) light in the presence of ozone (UVO) was used for surface treating carbon fibers. After UVO treatment, a PAN based carbon fiber had increased surface oxygen concentration, increased fiber tensile strength, and increased adhesion with an epoxy matrix. The beneficial effects of this surface treatment for carbon fibers were investigated. (D7:16)

Synthesis and Characterization of Grafted Polymer Conformations on Nanoparticles by Raft Polymerization
D Dukes*, S Lewis, L Schadler, Y Li, B Benicewicz Rensselaer Polytechnic Institute) M Tambasco, S Kumar (Columbia University)
The brush height of polystyrene chains grafted to silica nanoparticles of varying graft density and molecular weight was measured by dynamic light scattering. The brush height scales as N4/5 in the concentrated brush regime and the first clear evidence of a transition to semi-dilute behavior is observed at high molecular weight. (ID7:1)
Interfacial Fracture Toughness Measurement and Improvement for Composite/Metal Interfaces
W-S Kim, J-J Lee (KAIST)
The present study is concerned with the analysis of mixed mode fracture for composite/metal interfaces. The interfacial fracture toughness was measured over a wide range of mode-mixities with single-leg bend test specimens. The effect of surface structure on adhesion strength is investigated using micro-patterns on steel surfaces. (ID7:2)

Setting up of Pull-Out Test at Impact Strain Rates for SMA Wire/PCBT Adaptive Composite
J Zurbitu, A Agirregomezkorta, A Sarrionandia, G Castillo, I Urrutibiasoa, J Aurrekoetxea (Mondragon Univ)
The interfacial strength of SMA wire/pCBT composite for impact applications has been studied. These materials are strain rate dependent, so that the effect of this parameter on the interfacial strength has been characterized by a new pull-out test method. The interfacial strength increases with the strain rate and is high enough to induce the stress induced martensitic transformation in the SMA wire. (ID7:3)

The Effect of Sizing on Mechanical Properties of CF/BMI Composites under Hygrothermal Condition
Y Zhao, T Feng, Y Luo, Y Duan, Z Zhan (Beihang Univ)
The flexural properties and ILSS of CF/BMI composites with different sizing on carbon fiber have been tested before and after they were soaked in water at 71°C for seven days. The mechanical properties of CF/BMI with sizing A on the CF under hygrothermal condition are of low quality. (ID7:4)

Debonding at Elevated Temperatures in Polypropylene Composites: Effect of Particle Shape
K Jayaraman, K Shipley (Michigan State Univ) K Nichols, M Mazor (Dow Chemical Co)
Debonding at the polymer-glass interface was investigated in stretching of glass flake filled polypropylene and glass bead filled polypropylene at temperatures from 130°C to 150°C. The debonding stress for glass flakes is higher than for glass beads but it decreases more rapidly with temperature for the flakes. (ID7:5)

Evaluation of GFRP Strength under Water Environment Considering Interfacial Strength Degradation
M Kotani, Y Shibata, H Kawada (Waseda Univ)
Degradation of GFRP under corrosive environment is caused by the interaction between the accumulated microscopic damages. Besides, damage of GFRP's constituents under corrosive environment is consisted of the microscopic stress-corrosion cracking (SCC). Present research focuses on the degradation of interface and fiber reinforcement among its microscopic damages and to evaluate the strength degradation of GFRP. (ID7:6)

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