

EFFECT OF COPOLYAMIDE SURFACE TREATMENT TO CARBON FIBER ON INTERFACIAL PROPERTIES OF CF/PA12Department of Biomedical Engineering, Doshisha University, JAPAN K. Tanaka, S. Yagyu, M. Kawaguchi and K. Watanabe

INTRODUCTION

Improvement of the fiber/matrix interfacial strength of Carbon fiber reinforced thermoplastics

- Surface treatment: Copolyamide resin
- **Optimization of the amount of coating**

RESULTS AND DISCUSSION

FE-SEM images of As-received-sCF, Unsized-sCF and Htreated-sCF





MATERIAL AND EXPERIMENTAL PROCEDURE

Material

- Fiber: Spread PAN-based carbon fibers (24K Nippon **Tokushu Fabric**)
- Matrix: Polyamide 12 (PA12, 3014U, Ube Industries, Ltd., Japan)
- Surface treatment agent: Copolyamide emulsion (Sepolsion PA200, Sumitomo Seika Chemicals Co., Ltd., Japan) for water-based emulsions with thermoplastic resin

Removal Method of Sizing Agent from Spread Carbon Fibers

- Chemical vapor deposition system (MPCVD-70, Microphase Co., Ltd.)
 - in Ar atmosphere
 - at 350 °C
 - for 20 min





(b) Unsized-sCF

As-received-sCF (a)





(c) H-treated(30)-sCF (d) H-treated(50)-sCF





(e) H-treated(70)-sCF

(f) H-treated(90)-sCF

- The slower the pull-up speed was, the more the exposed carbon fibers were observed.
- The molten copolyamide covered the entire fiber in the H-treated (90)-sCF.
- As-received-sCF: Spread carbon fiber as received which is treated with the sizing agent
- **Unsized-sCF: unsized carbon fiber**

Application of Copolyamide Surface Treatment to Spread Carbon Fibers

- Coating: High speed dip coater (DC4300, Aiden Co., Ltd.)
 - Pull-up speeds: 30 mm/s, 50 mm/s, 70 mm/s, 90 mm/s.
- Heat treatment: Convection oven (DV340S, Yamato Scientific Co., Ltd.)
 - at 140 °C
 - for 120 sec
- H-treated(30)-sCF
- H-treated(50)-sCF
- H-treated(70)-sCF
- H-treated(90)-sCF

Single Fiber Pull-out Test

Testing machine for micro material (MMT-11N Shimadzu Co., Japan, load capacity: 2.5N) at a displacement rate of $1.67 \times 10-6$ m/s (0.1) mm/min) **Interfacial shear strength:** τ Maximum load: F max **Embedded fiber length: I** Diameter (d) of each pulled-out fiber using SEM after each pull-out test

Interfacial shear strength obtained by single fiber pullout tests



H-treated(50)-sCF/PA12 showed the highest interfacial strength between carbon fiber and matrix resin. In the cased that the pull-up speed is faster than 50 mm/s, interfacial strength between the carbon fiber and matrix resin showed lower values as the amount of coating increased.

CONCLUSIONS

The amount of coating for the highest interfacial shear strength has to be optimized and in this case Htreated(50)-sCF/PA12 has the highest interfacial strength.

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