10th International Conference on Composite Science and Technology
ICCST/10
A. L. Araújo, J. R. Correia, C. M. Mota Soares, et al. (Editors)

Abstract ID-131

FRICTION AND WEAR PROPERTIES OF HIGH MODULUS PITCH-BASED CARBON FIBER REINFORCED PLASTICS WITH SIC NANOPARTICLES

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Keywords: CFRP, SiC, Nano-particle, Laminate, Friction, Wear

Summary: In anticipation of movement in CO2 emissions reduction measures and introduction of electric vehicles, the needs for lightweight transport machinery such as automobiles is ever-increasing. For automotive lightening, application to the structure of Carbon fiber reinforced plastics (CFRPs) as a material alternative to metal has attracted attention.CFRP have become a dominant material in the aerospace, automotive and sporting goods industries. Extensive research and development in CFRPs led to remarkable improvements in the performance of the system, which exhibits excellent in-plane properties. Another critical drawback in structural composites is the presence of matrix-rich regions formed in the surfaces and gaps between the laminates. These regions are difficult to reinforce with traditional micro-scale reinforcement. Various nano-scale materials have been explored for selective reinforcement of matrix-rich regions.

There is a possibility that nano-organization dose not damage the fiber and is less impact on the organization of particle volume fractions. To apply the CFRPs in sliding parts, it is necessary to reinforce the surfaces and gaps. Ever, by adding the particle to gaps, research of suppressing delamination and interlaminar crack is conducted. We focused on that research, and investigated effects that different particle volume fractions in CFRPs adding the particle to the surfaces and gaps give to Flexural strength, Friction, and Wear characteristics.

In the present work, the flexural, friction, and wear properties of high modulus pitch-based CFRPs with 130 nm _-SiC nanoparticles were investigated. SiC is used in sliding member because it has third hardness all over the world. In addition, it has a lot of characteristics, so we consider that SiC-particles add new functionality to CFRPs. Prepreg consists of pitch-based carbon fiber (K13C) and Cyanate ester matrix (EX-1515). Fiber orientation of the CFRPs was set to [0]8. The fiber volume fraction of the CFRPs was 53.1 vol%. Four different particle volume fractions (1.0, 2.0, 5.0 and 10 vol%) were used for the inclusion. CFRP was manufactured by Autoclave molding. Molding conditions is at 120°C and 0.49MPa for 4h and at 135°C and 0.49MPa for 2h (rate of temperature increase : 1°C/min) in vacuum packing state.

Flexural tests of CFRP specimens were performed using a universal testing machine (Shimadzu, Autograph AG-series). The flexural strength of the particles filled CFRPs were higher than that of unfilled CFRP. Especially, the large enhancement was observed in 2.0 vol% particles filled CFRP. Flexural strength in 5.0 and 10vol% particles filled CFRP was decreased. Friction tests of CFRP specimens were performed using a ball-on-disk tester (**). The molded CFRP is unidirectional composite material, and wear mode was different in the fiber degree direction respect to sliding direction. In particular, the fiber 0 degree and 90 degree direction is very different. The friction coefficient of 2.0 vol% particles filled CFRP was the higher than that of unfilled and 1.0, 5.0 and 10.0 vol% particles filled CFRPs and wear mode could not be observed in the 2vol% particles filled CFRP.