CUP-STACKED TYPE CARBON NANOTUBES AND ITS NANO-COMPOSITES APPLICATION

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1 Introduction

Cup-Stacked Type Carbon Nanotubes (CSCNT) are obtained by Floating Reactant Method of Catalytic Chemical Vapor Synthesis (CCVS) [1]. This novel carbon nanotubes containing peculiar features provide the diversity of CNT from basic science to application field. Especially, CSCNT reinforced polymer composites are now known as the one of the most promising application.

While Carbon Fiber Reinforced Plastics (CFRP) has been widely used as a material for the high- strength and lightweight structures due to very high tensile strength, the compression strength and inter laminar share strength are much lower than the tensile strength. The several trials to improve compression strength or laminar strength of CFRP by using nano materials like nano-carbons have been done, but there are still difficulties of the dispersion and the adhesive strength between nano-materials and matrix materials.

CSCNT as nano-carbon reinforcement shows the most likely candidate to improve these problems thanks to the morphology.

2 Cup Stacked Type Carbon Nanotubes

FE-SEM image at low magnification reveals relatively long and straight carbon nanotubes as compared with that of conventional tubular type, showing diameter ranging from 80 to 100 nm and average length around 10 μ m (Fig.1).

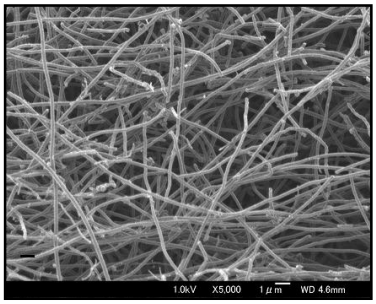

Fig.1 FE-SEM image of CSCNT

HR-TEM image at high magnification reveals stacking morphology of truncated conical sheets containing some angles to fiber axis and because of this angles, a large portion of the graphene edges are exposed and opened at the apparent tube surface as well as inner hollow core. This hollow core of cup-stacked type shows not only large size continuously, but also no bridge in the central hollow core that makes relatively thin wall thickness compared with large hollow core diameter (Fig.2).

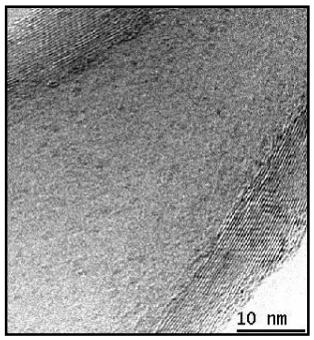

Fig.2 HR-TEM image of CSCNT

3 Experiment

3.1 Materials and specimen

In this experiment, the length of CSCNT has adjusted by industrial method to about 1 micron meter, and dispersed into epoxy resin EP827 (Japan Epoxy Resin Co., Ltd.) The loading ratio of CSCNT was 12wt% against Epoxy resin. After put hardener, CSCNT dispersed resin has impregnated into unidirectional carbon fiber (Toray T700SC 125g/m2). Then, this carbon sheet has dried by heater to make Pre-Preg. Resin content of Pre-Preg is 30%.Then, blank Pre-Preg was made by the same process. These Pre-Preg has cured 130degree C x 2hr by auto crave. Uniform dispersion and well infiltration have been observed by SEM images(Fig.3).

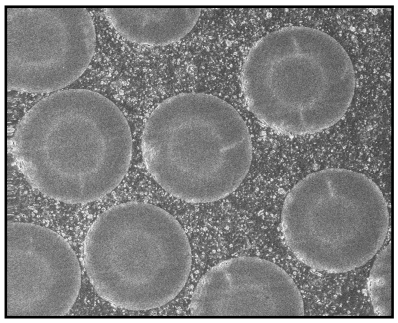

Fig.3 FE-SEM image of CSCNT dispersed CFRP

3.2 Test Result

Static Compressive strength of CSCNT-CFRP increased by 25% and Inter Laminar Share Strength (ILSS) was increased by about 10 to 20% in comparison with blank CFRP(Fig.4 and Fig.5) [2].

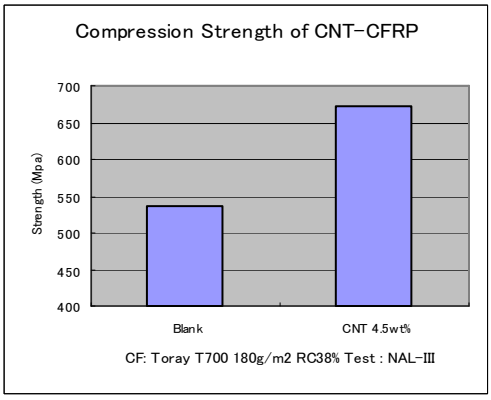

Fig.4. Compression Strength of CSCNT-CFRP

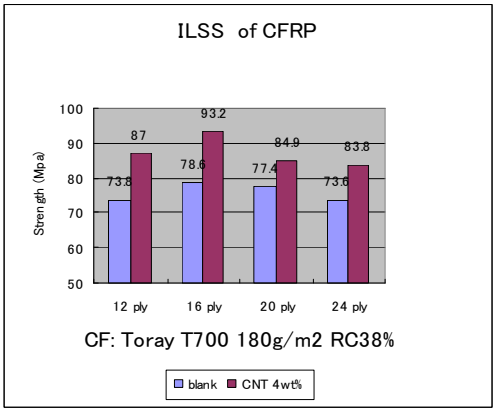

Fig.5. ILSS of CSCNT-CFRP

4 Conclusions

In this study, the characteristics and the application of the novel cup stacked type carbon nanotubes are discribed as follows;

1) CSCNT has stacking morphology of truncated conical graphene sheets with large hollow core which lead good surface activity.
2) CSCNT can be well dispersed into epoxy resin.
3) CSCNT dispersed resin is well infiltrated into carbon fiber bundles.
4) CSCNT dispersed CFRP registers great improvement in compression strength and ILSS.

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References

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