PREPARATION AND CHARACTERIZATION OF HIGHLY ORIENTED CARBON NANOTUBE/EPOXY NANOCOMPOSITES USING MAGNETICALLY ALIGNED SWNT BUCKYPAPERS

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Introduction

Alignment of single-walled carbon nanotubes (SWNTs) is critical for developing high performance nanostructured materials and devices. Several research groups have experimentally proven that magnetic alignment of carbon nanotubes is effective means to achieve substantial tube alignment [1-4]. In this research, a unique technical approach was developed to fabricate quasi-unidirectional SWNT/epoxy nanocomposites for demonstrating the effects of tube alignment on structural and thermal/electrical properties of the resultant materials. Instead of directly mixing nanotubes and resin, a special resin infiltration method was used to impregnate buckypapers, which are thin preformed sheets of well-controlled and dispersed porous SWNT networks. Magnetically aligned buckypapers were produced by filtering well-dispersed nanotube suspensions in 17.3 Tesla magnetic field at NHMFL. The aligned buckypapers were 15-30μm thick with a 387cm^2 (60 in^2) working area. Multiple-layers of resin-wetted aligned buckypapers were stacked together with identical tube orientation direction and cured to fabricate solid bulk composite samples with desirable quasi-unidirectional alignment of SWNTs.

Results and Discussion

The SEM observations of the cross-sections of the resultant composites show significant alignment of the nanotubes along the desired direction, as shown in Figure 1. The dynamic mechanical analysis also shows that the storage moduli of the quasi-unidirectional SWNT composite samples were as high as 45.0GPa, more than sixteen times higher than that of the neat epoxy resin matrix.

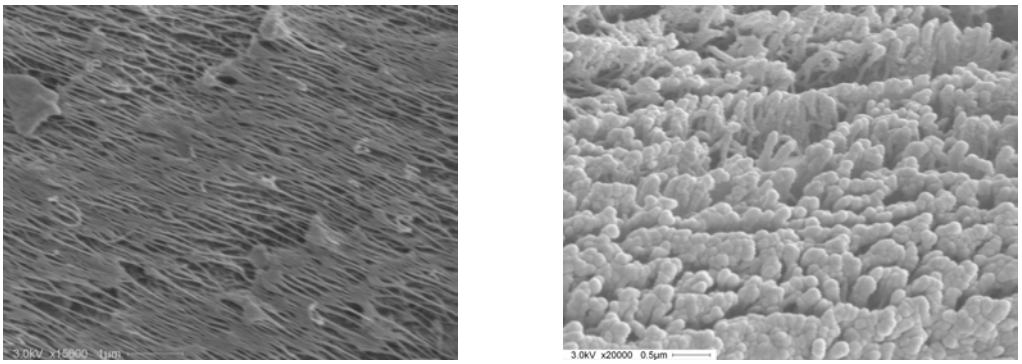

Figure 1. Significant alignment of SWNTs in magnetically aligned buckypaper/epoxy nanomaterial

Conclusions

The results show that this novel processing approach of magnetically aligning SWNT buckypapers can effectively fabricate bulk nanostructured materials with desired alignment and high tube loading, which are critical for developing high performance SWNT-based nanomaterials and devices.

Acknowledgements

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