THIN PAPER BASED ON VAPOR GROWN CARBON FIBER

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INTRODUCTION

This study investigated the use of vapor-grown carbon fiber (VGCF) for fabricating paper less than 50 mil thick. As-grown fiber mats were cut to nominally 25 mm lengths, dispersed in aqueous solution along with poly(vinyl alcohol) fibers as a binder, and hand cast into sheets. Various stirring methods and binder contents were used and their effect on paper quality and handleability investigated. The distribution and orientation of VGCF in paper were examined.

Various carbon fiber papers are commercially available for use as composite surfacing veils, as electrically conductive members in otherwise non-conductive composites, and as structures for filters and adsorbents. All of the commercial carbon fiber papers are fabricated from chopped PAN or pitch fibers.

Due to the nature of VGCF growth, this fiber can not be used in many traditional composite forming processes since it is not a continuous tow fiber. However, for some applications, particularly those requiring a planar isotropic thermal expansion coefficient, an isotropically oriented, non-woven mat structure would be ideal. Such a mat or paper could be formed in very long lengths and wrapped, prepregged, plied, or otherwise consolidated into composites by traditional means.

EXPERIMENTAL

VGCF mats are typically stacked and cut to size for composite molding. Miscellaneous cuttings and end pieces from this operation were collected and further cut to nominally 25 mm lengths. These "chopped" fibers were then dispersed in water with small amounts of surfactants and poly(vinyl alcohol) fibers as a binder. After dispersion in a blender, the material was filtered over metal screens and dried to form a 8x8 in (20x20 cm) sheet. After drying to remove the water, the sheets were transferred from the screen and evaluated for various uses including composite fabrication and as a substrate for diamond deposition.

RESULT

The resulting sheets were all fairly thick, on the order of 1 mm. The sheet formed with no binder had almost no strength and could not be handled without damage. The sheets with 3 and 5 weight percent PVA binder could be handled and cut. The areal

and volume densities of all sheets were very similar and on the order of 95-115 g/m^2 and 0.095-0.115 g/cm^3, respectively. Based upon this density, the sheets are on the order of 5-6 volume percent fiber. Thus, these may be very useful for catalyst or other supports, but are almost of too low a volume fraction for fabricating composites.

Fiber sheets were examined using optical and scanning electron microscopy (SEM) to evaluate the degree of damage to the fibers and the fiber orientation distribution. Fig. 1 shows an SEM micrograph of VGCF paper, in which fiber damage is not seen. While the majority of the fibers are shorter than the initial 25 mm length, they are still long enough to support a coherent sheet. At long mixing times in the blender, it is possible to reduce the fibers to lengths too short for fabricating self-supporting sheets.

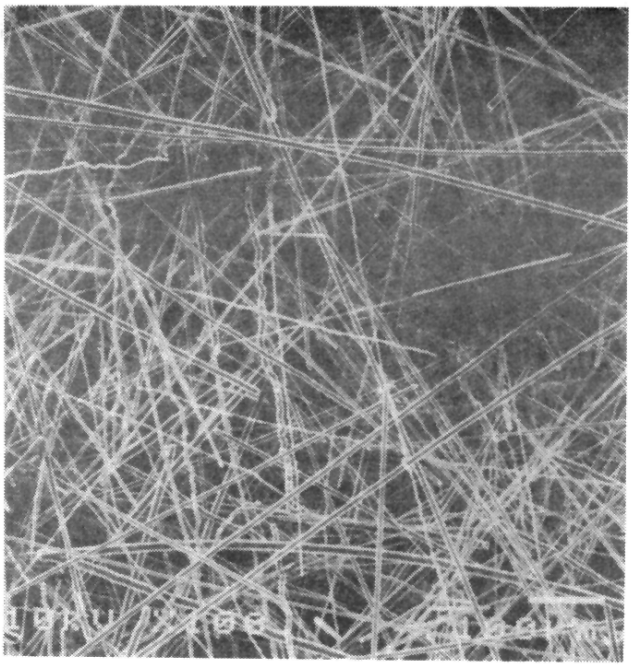

Fig. 1. SEM micrograf of VGCF paper.

CONCLUSION

Low volume fraction, non-woven mats or papers can be fabricated from vapor-grown carbon fiber. For some applications this technique may be a preferred method of fiber handling. By forming an isotropic fiber architecture in the plane, lengthy manual fiber lay-up can be avoided. Future efforts will investigate the degree of translation of fiber thermal conductivity and coefficient of thermal expansion into such paper structures.