Improved Mechanical Properties of Bucky Paper Achieved via the Addition of Carbon Nanocoils

Koji Maruyama[a], Yoshiyuki Suda[a], Hideto Tanoue[a], Hirofumi Takikawa[a], Hitoshi Ue[b], Kazuki Shimizu[c], and Yoshito Umeda[d]

[a]*Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku, Toyohashi, Aichi 441-8580, Japan*
[b]*Fuji Research Laboratory, Tokai Carbon Co., Ltd., 394-1 Subashiri, Oyama, Sunto, Shizuoka 410-1431, Japan*
[c]*Development Department, Shonan Plastic Mfg. Co., Ltd., 31-27 Daikan, Hiratsuka, Kanagawa 254-0807, Japan*
[d]*Toho Gas Co., Ltd., Tokai, Aichi 476-8501, Japan*

Abstract. The Young's modulus of buckypaper (BP) was improved via the addition of carbon nanocoils (CNCs). The Young's modulus was the highest when the added amount of CNCs of the mass of the bucky paper was 11.9%. It is likely that the improved Young's modulus was due to the higher Young's modulus of the CNCs, compared with the multi-walled carbon nanotube (MWCNT) bundles. The helical structure of the CNCs also contributed to the improvement in the Young's modulus. In the BP containing CNCs, the CNCs were anchored in the MWCNT matrix with superior entanglement, and this effect improved the Young's modulus of the BP.

Keywords: buckypaper, carbon nanocoils, carbon nanotubes, Young's modulus.
PACS: 46.70.-p, 78.67.Sc, 81.05.uj, 81.70.Bt

1. INTRODUCTION

Buckypaper (BP) is an entangled array of carbon nanotubes (CNTs) arranged as a planar film, held together by Van der Waals interactions at the tube–tube junctions. The properties of BP make it a useful candidate material for radio frequency filters [1] and cold-field cathode emitters [2], and a potentially useful material for substrates in nano-bio interface research, for applications such as supporting the growth of osteoblasts [3], nerve cells [4], and retinal cells [5]. The strength of BP means that it also has potential as a reinforcement material in aircraft components. In this study, we prepared BP using multi-walled carbon nanotubes (MWCNTs), and improved the mechanical strength of the resulting materials by adding carbon nanocoils (CNCs) (Figure 1) to the BP. CNCs are carbon nanofibers with a helical shape, and their structure is amorphous. CNCs have been used as a reinforcement material in epoxy resin [6]. In this case, the CNCs demonstrated their good mechanical interlocking properties in the epoxy resin. Here, this property was applied to improve the Young's modulus of BP. The Young's modulus of BP was measured as the amount of CNCs added was varied, and the resulting changes were discussed.

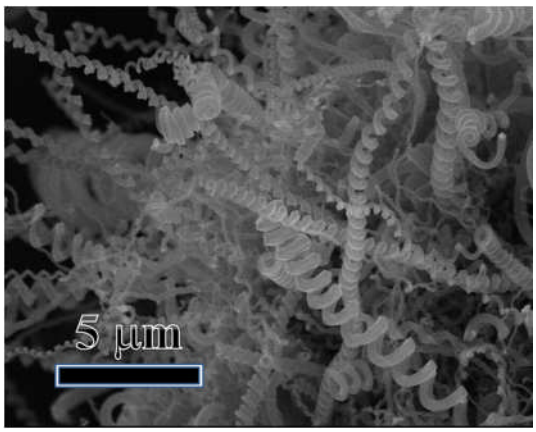

FIGURE 1. Scanning electron microscopy (SEM) image of CNCs.

The Irago Conference 2013
AIP Conf. Proc. 1585, 89-96 (2014); doi: 10.1063/1.4866624