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Magnetic Processing of MWCNT/Polymer Composite Film

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Carbon nanotubue (CNT) and carbon fiber (CF) have outstanding mechanical, thermal, and electrical characteristics, and they have strong anisotropy. To take advantage of the enhanced these properties of CNT in polymer composites, the orientation control of CNT should be important. The conventional polymer melt processing for film using flow and drawing can align CNT along horizontal film surface direction, but not along vertical. In recent years, magnetic processing by using anisotropic diamagnetism of CNT (no metal catalyst residual) or CF have been actively studied to align CNT or CF along various directions. In the present study, we have performed the magnetic processing of polymer composite films including multi-walled carbon nanotube (MWCNT) by using our magnetic processing apparatus with permanent magnets (1T) and a commercially available superconductive magnet (10T) has been used for comparison permanent magnets. We have studied the orientation of MWCNT along the thickness direction of the film. The orientational distribution of MWCNT was analyzed by three dimensional optical microscope analysis in addition to X-ray diffraction. It was demonstrated that the oriented MWCNT / polymer composite films were produced even by permanent magnets. The electric volume resistivity (Ω·cm) of the film (vertically oriented MWCNT, 1wt.%, thickness was 10μm), was improved from 2.1E+3 Ω·cm to 2.1E+0 Ω·cm by using permanent magnet (1T). Our study suggests that magnetic processing, a new processing method, will be able to fabricate orientationally controlled MWCNT composite materials, which have potential application in many fields, such as separator of full cell, electric adhesion bond, anisotropic conductive film and field emission display.