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Electric Processing of MWCNT/Polymer Composite Film

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Multi-walled carbon nanotube (MWCNT) / polymer composites have promising electric and mechanical property. It is critical to reduce the amount of MWCNT with keeping the enhanced property. Thus, it becomes important to control the direction of MWCNT in polymer composites. Magnetic or electric processing is a solution to align MWCNT. Here, we have investigated the fundamental orientation feature of MWCNT under dc electric field, compared with that under magnetic field. Furthermore, we have recently developed polymer composite film including aligned MWCNT along film thickness direction by dc electric processing. A trace amount of MWCNT, which had aggregated lump form as received, was completely dispersed in polydimethylsiloxane, as a model matrix, by mechanical stirring. By using the uniform dispersion as the starting material, the application of dc electric or magnetic field was used to induce the formation of aligned structure. In-situ transmission optical microscope observation was carried out to observe structural development of MWCNT, where magnetic or electric direction was parallel and perpendicular to the observation direction. Aligned ramified network structure of MWCNTs was finally developed between electrodes under dc field. On the other hand, magnetic field generated the orientation of MWCNT without networking. Based on the above fundamental results, we have developed low density polyethylene film including a trace amount of aligned MWCNT along film thickness direction by dc electric processing with an optimal processing temperature profile. It was demonstrated that the electric volume resistivity (ohm-cm) was around 10 with 0.1wt% of MWCNT after electric processing, showing the effectiveness of electric processing in controlling the alignment of MWCNT.