Structure and properties of electrical conductive microcellular plastics filled with carbon nanofiber

Shigeo Asai, * Akira Kuragano, and Shuichi Akasaka

Department of Chemistry and Materials Science, Tokyo Institute of Technology,
2-12-1-S8-43 Ookayama, Meguro-ku, Tokyo 152-8550, Japan
*e-mail: asai.s.aa@m.titech.ac.jp

The electrical conductive microcellular plastics were made by the high-pressure carbon dioxide treatment of PMMA and PMMAPE blends filled with vapor grown carbon fiber (VGCF). The foam structure and electrical properties of the PMMA/VGCF and PMMA/PE/VGCF composites were dependent on the filler content, the initial filler dispersion state, and the conditions of foaming such as pressure and temperature. In case of small filler content, the electrical resistivity largely increased after foaming in consequence of the breaking of conductive filler network. Therefore a larger amount of filler is necessary to make the conductive microcellular composite. To avoid the breaking of conductive filler network by foaming, we had tried to reinforce the filler network by using the following two methods. One method is that harnessing the dynamic percolation phenomenon, which is the time evolution of filler network during the isothermal annealing at a temperature much higher than the glass transition temperature of the polymer matrix [1]. Another method is that using a self-assembled conductive filler network in PMMA/PE/VGCF composites, in which the VGCF fillers are connected with small amount of PE [2]. As shown in Figure 1, the electrical conductive microcellular plastics with relatively small filler content have been successfully made by controlling the initial filler dispersion state and stabilizing the filler network.

Figure 1   Electrical resistivity of four kinds of microcellular composites.
(×: as-mold PMMA/VGCF, Δ: annealed PMMA/VGCF,
□: as-mold PMMA/PE/VGCF, ○: annealed PMMA/PE/VGCF)