Absorption Current Behaviour of Polyethylene/Silica Nanocomposites

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Absorption current is considered to be one of the important characteristics of polymers with regard to their time-domain response to direct current (DC) poling field. This is because the results of the absorption current measurements can be used to gain understanding on the relationship between the space charge accumulation and movement. In semicrystalline polyethylene for example, charge accumulation is likely due to the presence of the trapping sites caused by the interfaces between the crystalline and amorphous phases. With the addition of nanofiller into polymer, the charge transport mechanism could be more complicated than that of the unfilled polymer as the inclusion of nanofiller will introduce the nanofiller/polymer interfaces. The presence of such interfaces will affect the current flow due to the introduction or modification of the trapping sites, through which the charge carrier may move easily through the nanofiller/polymer interfaces, depending on the characteristics of the interfaces. In this paper, we report on an investigation into the absorption current behaviour of polyethylene nanocomposites containing 0 wt%, 2 wt%, 5 wt% and 10 wt% of silica nanofiller, either untreated or treated using trimethoxy(propyl)silane coupling agent. Our results indicate that the absorption current behaviour of the polyethylene was affected by the presence of the nanosilica. While the current behaviour through the unfilled polymer decreases with time in a conventional manner, all nanocomposites reveal an initial decrease followed by a period in which the current increases with increasing time of DC field application. However, at a reduced DC field, the treated nanocomposites exhibited different behaviour from the untreated counterparts.

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