Thermal analysis of PE + X%CNT

Naoui Y.[1], Zahaf A.[1], Revo S.[2], Boubertakh A.[1], Hamamda S.[1]

1 - Laboratory of Thermodynamics and Surface Treatment of Materials Université des Frères Mentouri, B.P. 325 Route Ain El Bey, Constantine 25017, Algeria

2 - Taras Shevchenko National University of Kyiv, 64/13, Volodymyrska Street, 01601 Kyiv, Ukraine

shamamda@yahoo.com

The purpose of this note is thermal analysis of polyethylene (PE) containing multiwall carbon nanotubes (CNTs). To make this work, several analysis techniques were used. We took pure high density polyethylene in which we introduced three different concentrations 0.5%, 1% and 2.5% CNTs. The measurements of dimensional change, the coefficient of thermal expansion and thermogravimetry were made in the temperature range 20-110 °C.

The Raman spectra of the studied samples show that the intensities of the peaks present on the four curves $I = f(\lambda)$ are different. The curves of the pure samples and those containing 0.5% CNTs are superimposed. The intensities of PE anomalies 0.5% CNTs are superior to those of pure material. As the spectra of Samples 1% and 2.5% CNTs, they have the same shape but different intensities. The nanomaterial PE + 2.5% CNTs is less than three.

Spectroscopic analyzes obtained by infrared reveal a significant intensification due to the introduction of the nanotubes in the polyethylene. The shapes of the curves of three samples containing nanotubes have changed shape and became more intense before that of pure polyethylene. When the concentration is 1% CNTs, the spectral intensity of PE nanomaterial + 1% NTC is of the utmost importance.

The dimensional changes of the four samples are highly dependent on the measuring direction. PE relative change + 1% CNTs in the longitudinal direction is the lowest compared to the other throughout the temperature range studied. Similarly the radial direction, the same nanocomposite has the lowest dimensional change before the other three.

The dilatometric measurements were made using both radial and longitudinal directions.

The results obtained show that the thermal expansion coefficient of the nanocomposite PE + X% CNT changes from the radial direction to the longitudinal direction regardless of the carbon nanotubes concentration.

In the radial direction, the expansion PE + 2.5% NTC is higher than the other three in the entire temperature range and exhibits a very intense peak at 95 ° C which does not appear in the three other.

In the longitudinal direction, the expansion behavior of the nanocomposite totally changes. The pure material has a coefficient of thermal expansion at very large the other three. The four curves each contain a peak at around 50 °C. Its intensity depends on the concentration. When the amount introduced into the matrix is 1%, the dilatometric anomaly appears at 55 °C and its intensity is the lowest before the other three. The nanocomposite is anisotropic.

The nanocomposite PE + 1% NTC expand the text before the other three regardless of the measuring direction.

Analysis calorimetric curves reveal than polyethylene containing 0.5% CNT is above the three other to a temperature slightly above 90 °C whereas the three other overlap. Around the temperature 95 °C, the four curves each contain a calorimeter anomaly spread over 15 °C and the maximum of which is located around 100 ° C. From 105 °C, all the curves merge and decrease sharply.

Regarding thermogravimetry, four samples have curves with similar shapes. Nanomaterials containing 1 and 2.5% CNTs have curves that overlap and intensity are substantially equal. As for the PE sample + 0.5% CNTs, the TG curve is most intense before the three others for the whole temperature range.

Key words: Nanocomposite, Thermal Expansion Coefficient, Polymer, Carbon nanotubes, Anisotropy.