Секция «Биофизика и нанобиотехнологии»

Curing effect on the temperature coefficient of resistance (TCR) for single-walled carbon nanotube nanocomposite

Научный руководитель – Abaimov Sergey

Jafarypouria Milad
Postgraduate
Сколковский институт науки и технологий, Информационные технологии, Москва, Россия
E-mail: Milad.Jafarypouria@skoltech.ru

The temperature coefficient of resistance (TCR) determines the electrical performance of materials in electronics. For a carbon nanotube (CNT) nanocomposite, change of resistivity with temperature depends on changes in CNT intrinsic conductivity, tunneling thresholds and distances, matrix' coefficient of thermal expansion, and other factors. In our study, we add one more influencing factor–the degree of cure. Complexities of the curing process cause difficulties to predict, or even measure, the curing state of the polymer matrix while uncertainty in the degree of cure influences TCR measurements leading to biased values. Here we study the influence of the cure state on the TCR of a single-walled CNT/epoxy polymer nanocomposite. For the given degree of cure, TCR measurements are conducted in the temperature range 25–100 °C, followed by the next 24 h of post-curing and a new cycle of measurements, 8 cycles in total. We find that contrary to industry practice to expect a high degree of cure after 3 h at 130 °C, the curing process is far from reaching the steady state of the material and continues at least for the next 72 h at 120 °C, as we observe by changes in the material electrical resistivity. If TCR measurements are conducted in this period, we find them significantly influenced by the post-curing process continuing in parallel, leading in particular to non-monotonic temperature dependence and the appearance of negative values. The unbiased TCR valueswe observe only when the material reaches the steady state are no longer influenced by the heat input. The dependence becomes steady, monotonically increasing from near zero value at room temperature to 0.001 1/°C at 100 °C.