

Nanomaterials and nanocomposites

Resistive acetone vapor sensors based on cross-linked polyurethane/carbon nanotube composites

Yu.V. Yakovlev, Eu.V. Lobko, Z.O. Gagolkina

Department of polymer physic, Institute of Macromolecular Chemistry. Nat. Acad. of Sci. of Ukraine. Kharkivske chaussee, 48, Kyiv-02160, Ukraine.

E-mail: lobko_zhenia@i.ua

Carbon nanotube-filled polymers arouse significant scientific interest due to possibility of creation of materials with industrial importance. Application of such polymer composites in the field of vapor sensing materials give some advantages in comparative cheapness and easiness of production sensor devices with best performance.

The sensing materials in our study were based on CPU and carbon nanotubes (CNT) composites. CPU was synthesized via stage of prepolymer based on 2,4-/2,6-toluenediisocyanate (80/20) and polypropylene glycol ($M_w = 1000$). CNT was sonicated in dichloromethane and then added *in situ* to CPU on crosslinking stage.

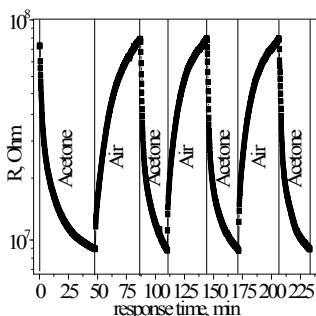


Fig.1 Resistance response of CPU/CNT sensors in acetone vapor.

resistivity increases due to swelling of the polymer matrix that is accompanied by conductive paths breaking. Peculiarity of the sensor response in our study is known in literature as negative vapor coefficient (NVC) effect. Possible explanation of such effect is process of reaggregation of the nanotubes with the concentration just below percolation threshold. The reaggregation process is coupled with the weakening of CPU/CNT interaction due to acetone vapor absorption. New arrangement of CNT favor to establish contacts between nanotubes and therefore the decreasing of resistivity takes place. When process of desorption of the acetone vapors in air occurs, enhancement of the CPU/CNT interaction breaks the CNT/CNT contacts that followed by the resistance increasing.

As shown on fig. 1 resistance of CPU/CNT (0.5 % wt.) sensor decreases from 80 to 9.1 M Ω in 40 minutes after exposition in acetone vapors. After that about 33 minutes of exposition in air leads to recovery of the resistance of the sensor to initial value (80 M Ω). Subsequent cycles of acetone/air exposition demonstrate rather uniform sensor response and saturation of the resistance takes about 25 and 32 minutes in acetone and air, respectively. However, most of the polymer composite sensors show opposite response and their