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Poster Presentation

ETHYLENE VINYLACETATE COPOLYMER AND NANOGRAPHITE PARTICLE COMPOSITE AS VOC SENSOR

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Introduction

One of the reasons for pollution is the great number of chemicals around us. Chemicals which can harm human health are everywhere in our life's, especially in manufacturing, where they are manufacturing products or by-products. Because of lack of mobile and accurate VOC sensing device workers of manufacture and in some cases even local citizens are exposed to high concentration of VOC.

For example toluene is used widely in the manufacture of polymers for plastic bottles and to make polyurethane and nylon, in the manufacture of cosmetics and in the manufacture of dyes and inks. Also toluene can be used as a fuel additive where it is used to increase the octane ratings and as a solvent in cleaning agents, adhesives, resins, paints and paint thinners. But OSHA (Occupational Safety & Health Administration) permissible exposure limit (PEL) for toluene in general industry is 200ppm that can cause central nervous system depression, causing fatigue, headache, confusion, paresthesia, dizziness, and muscular incoordination. But only 10 minutes in 500 ppm of toluene vapours can cause irritation of the eyes, mucous membranes, and target upper respiratory tract [1].

For this reason ethylene vinylacetate copolymer and nanographite particle composite was made in order to develop VOC sensor. With the term "nanographite" can be marked following fillers: extra-conductive highly structured carbon black (EHSCB), carbon nanotubes (CNT), thermally exfoliated graphite (TEG) as well as recently discovered graphene because all of them have a sp2-hybridized crystal structure like graphite, but at least one dimension of nanographite is smaller than 100 nm. In this research we used EHSCB as composite filler. Their primary nanoparticles are made of graphite platelets and therefore are extra-conductive.

Materials and methods

Ethylene vinyl acetate copolymer (Sigma Aldrich) was used as polymer matrix for the composite. From previous studies [2-3] it is cleared that amount of vinyl acetate in copolymer significantly affect its crystallization degree and flexibility, for that reason we used ethylene vinylacetate copolymer with 40 % vinylacetate content. Copolymer consists of ethylene and vinylacetate repeating units, where ethylene unit is non-polar and vinylacetate - polar. Copolymer complex structure indicates that the acquired composite material sensor could detect both polar and non-polar organic solvent vapours.

Nanographite particles (EHSCB: PRINTEX XE-2; CB) with average particle size 30 nm were used as conductive filler for first type of composites. Particles specific surface: 950 m^2/g and DBP (dibutyl phthalate) adsorption: 380 ml/100 g. PRINTEX XE-2 as mentioned before has high electrical and it has been used in many electrical rubber creation.

Composite was made by dissolution method were dissolved composite solution was obtained. Afterwards epoxy laminate plate with coper electrodes were coated with composite solution using dip-coating method.

Results and discussion

There were made various experiments that show EVA-CB ability to detect toluene in low concentrations. In figure 1 is shown relative electrical resistance change versus time in two concentrations of toluene vapours.

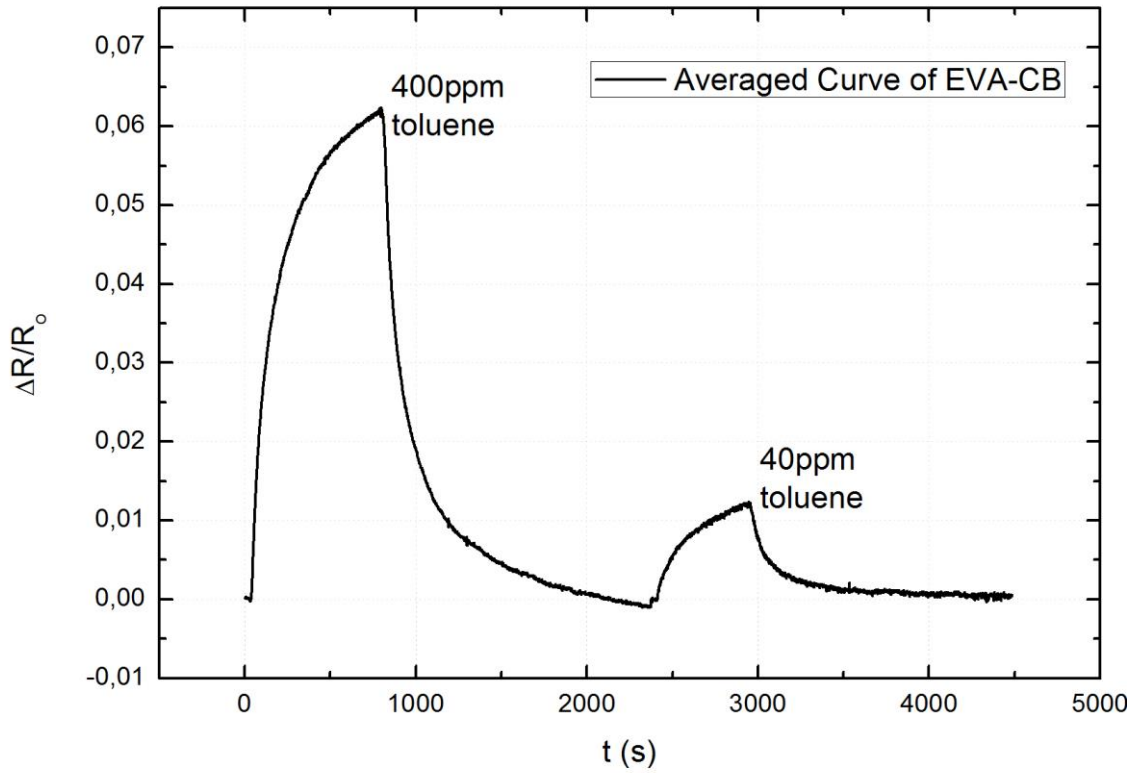

Figure 1. Relative electrical resistance change versus time in two concentrations of toluene vapours.

Results show that EVA-CB is able to detect toluene vapours at low concentrations and can detect differences in concentrations. Also there were made EVA-CB experiments in more polar vapours - ethanol. Results show different reactions on ethanol and toluene vapours at the same concentration. It can be explainable with EVA complicated structure, it's polar and nonpolar parts.

References

1. Federal Regulations (USA) Title 29: Labor, Part 1910 occupational safety and health standards (continued), Subpart Z-Toxic and Hazardous Substances, §1910.1000 Air contaminants.
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