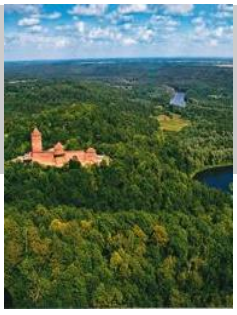
BALTIC POLYMER SYMPOSIUM

2015

PROGRAMME AND PROCEEDINGS



Sigulda, Latvia, September 16-18

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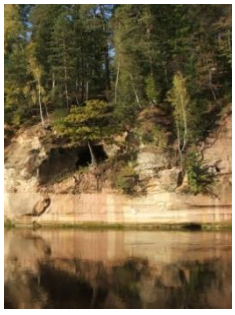

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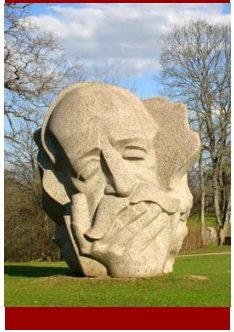

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POLYMER/NANOSTRUCTURED CARBON COMPOSITES FOR ENERGY HARVESTING

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Research represented in this work is an attempt to improve an efficiency of electrostatic harvesters. In such type of devices mechanical energy conversion to electrical energy is achieved through deformation of insulator (dielectric) layer between plates of charged capacitor. As a result of such deformation the capacitance of the capacitor is decreased and voltage between plates increased and, thus, charge of the capacitor can be stored at higher than initial voltage. To increase the change of voltage during the deformation of dielectric layer between capacitor plates, the use of elastic dielectric with variable dielectric constant is needed. The dielectric constant of such a dielectric should decrease with increasing distance between capacitor plates, i.e., with tensile deformation of dielectric layer. As a candidate for such a dielectric material polymer/nanostructured carbon (PNC) composite was chosen.

Capacitor samples containing PNC dielectric layer were elaborated from 1) SWR-3L natural rubber with added curing ingredients (this is used as a matrix); 2) high structure Degussa™ Printex™ EX-2 carbon black with average particle size 30 nm (filler); 3) two brass electrodes (thickness 2 mm). Brass electrodes were tightly attached to PNC composites during vulcanization (T = 150 ^{0}C, t= 15 min, p = 3 MPa). Diameter of samples is 18 mm, thickness is one millimeter. The concentration of filler in PNC composite was chosen to be slightly lower than percolation threshold. Tensile and compressive deformation of samples was realised using Zwick/Roell Z2.5 universal material testing machine. Measurements of dielectric constant were carried out on Agilent E4980A LCR meter.

Tensile and compressive deformation measurements conducted on PNC samples showed, that under tensile and compressive deformation dielectric constant of PNC composite is changing non monotonically (Fig.1.). The decrease of the dielectric constant with increasing deformation of the dielectric layer can be seen. It can also be seen, that character of dielectric constant change for both - tensile and compressive deformation - is different. The change of dielectric properties observed indicates about complex processes taking place in the PNC dielectric layer.

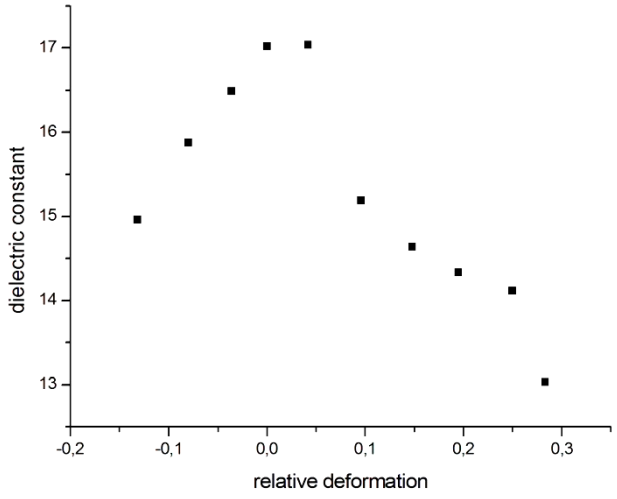

Fig.1. Dielectric constant of a composite (NR/CB6) as a function of relative deformation.