INVESTIGATION OF DOPANT EFFECT ON POLYPYRROLE TEXTILE COMPOSITES

Augustas Šukys[1], Monika Kirsnytė[1], Paulius Ragulis[2], Rimantas Simniškis[2], Žilvinas Kancleris[2], Raimonda Celiešiūtė-Germanienė[1], Arūnas Stirkė[1]

[1] Department of Material Science and Electrical Engineering, Center for Physical Sciences and Technology, Lithuania
[2] Department of Physical Technologies, Center for Physical Sciences and Technology, Lithuania,
augustas.sukys@chf.stud.vu.lt

Due to increased importance of information technology in communication field a huge attention has been focused on electromagnetic radiation (EMR) absorbers. Among well researched conjugated polymers, polypyrrole (PPy) is a cheap and tunable organic semiconductor which can be incorporated into fabrics to create flexible electronics or EMR shielding materials [1]. The aim of this work is to enhance conductivity of PPy by adding anionic dopants to create promising electrically conductive composite films for smart textile industry [2].

Two types of experiments were carried out: when dopant is in matrix and catalyst polymer solution or when dopant is in pyrrole (Py) monomer solution. 4 different dopants were used: sodium dodecyl sulfate (SDS), sodium polystyrene sulfonate (PSSNa), sodium dodecylbenzene sulfonate (DBSNa) and dioctyl sodium sulfosuccinate (DOSS). Composites were synthesized with only one dopant and on a dielectric woven wool substrate coated with polymerization reaction catalyst $FeCl_3$ evenly distributed throughout PVA (polyvinyl alcohol) adhesive polymeric matrix using screen printing with particular 3 x 3 cm square pattern. Coated specimens were dried at 60 °C then spray-coated with monomer Py and water solution and after quick polymerization reaction dried again at 60 °C.

Experimental investigations of manufactured samples have been performed using an analytical model of electromagnetic wave shielding effectiveness calculations in 8-40 GHz frequency range. Composites were characterized using scanning electronic microscopy and Fourier-transform infrared spectroscopy.

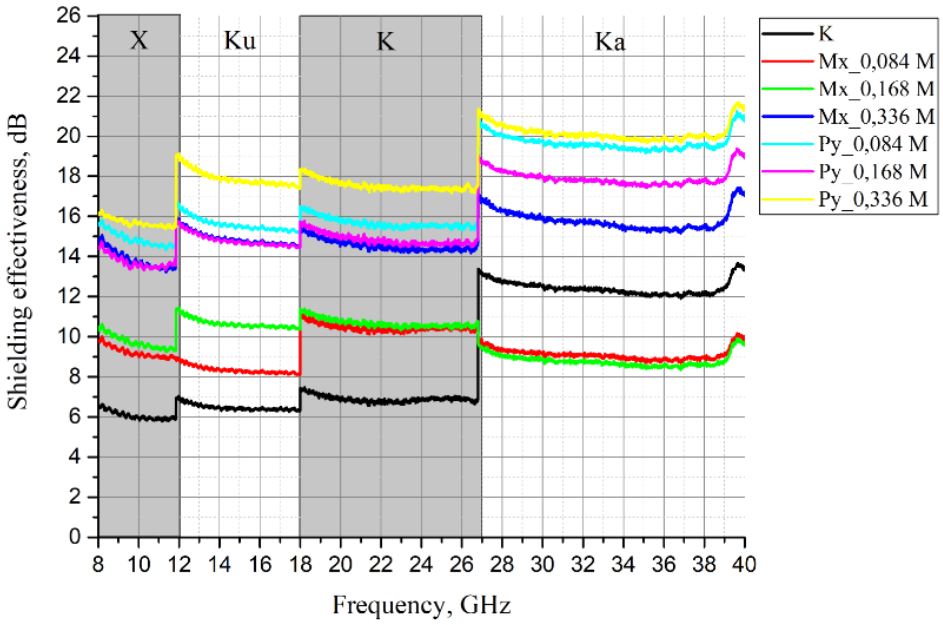

Fig. 1. Shielding effectiveness of PPy doped with SDS respectively 0,084 M; 0,168 M; 0,336 M, on woven wool in 8-40 GHz frequency range. K – no dopants; Mx – dopant is in the matrix solution; Py – dopant is in the Py monomer solution.

In conclusion, the most promising composite was achieved using SDS dopant with 0,336 M concentration, when dopant was in Py monomer solution. Comparing this composite with sample with no dopants, shielding effectiveness was improved approximately by ~9 dB. These results give a bedrock for doped polymer composites use in smart textile industry which can be used to develop commercially available flexible electronics.

[1] Takamatsu, S., et al., *Wearable Keyboard Using Conducting Polymer Electrodes on Textiles.* Adv Mater, 2016. **28**(22): p. 4485-8.
[2] Hazarika, J. and A. Kumar, *Controllable synthesis and characterization of polypyrrole nanoparticles in sodium dodecylsulphate (SDS) micellar solutions.* Synthetic Metals, 2013. **175**: p. 155-162.