ELECTROCHROMIC PROPERTIES OF CONDUCTIVE POLYMER AND TEXTILE COMPOSITES

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While color is an integral part of everyday life and can be used to reflect emotions, identify or alert, a change in color is even more powerful tool in terms of expression and communication. A promising way to produce color changing flexible displays is combining textiles with electrochromic electrically conductive polymers. There is a great potential provided by the conductive polymers due to the color manipulation possibilities [1], comparative ease of preparation [2] and rapid response times. This study investigates the combinations of electrochemically polymerized polyaniline and poly(3,4-ethylenedioxythiophene) (PEDOT) with two different textile substrates and explores its possible applications.

Electrochemical polymerization was carried out using three electrode system, where platinum wire served as counter electrode, silver wire as reference electrode and textile as working electrode. Polyester (PES) fabric with stainless steel fibers and copper-nickel coated PES (PES-Cu-Ni) textiles were used. Electrochemical depositions of polyaniline and PEDOT were performed by potential cycling, using 0.1 M aniline solution in 0.5 M sulfuric acid and 20 mM EDOT solution in acetonitrile with 0.1 M $LiClO_4$.

Electrochromic color change of polyaniline and PEDOT textile composites was investigated using video image analysis software ImageJ. By using an appropriate combination of red (R), green (G), and blue (B) intensities, many colors can be displayed. Using ImageJ it is possible to measure RGB channels' intensity changes. Measurements are based on analyzing separate pixels [3]. To ensure same lightning conditions all videos were filmed in special photography box (24x24x24 cm) with LED lights (Fig.1).

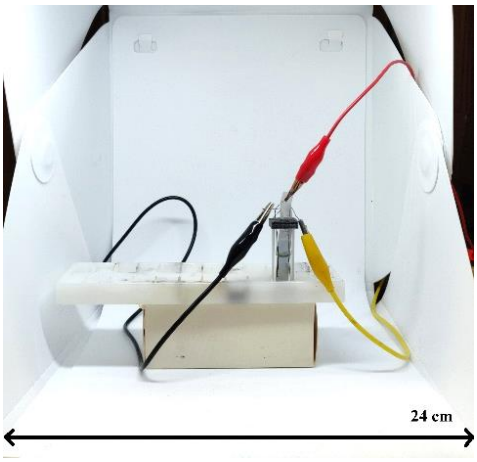

Fig. 1. Photography box with LED lights

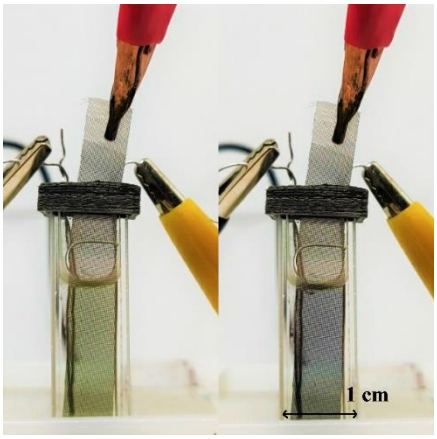

Fig. 2 Electrochromic color change of polyaniline

Both PES-Stainless steel and PES-Cu-Ni textiles demonstrated reversable electrochromic color change with aforementioned conductive polymers. For polyaniline observed color change was dark green-blue (Fig. 2.), for PEDOT from transparent to dark blue. This leads to a promising expectation that conductive polymers and textiles can be combined for further application developing communicative flexible devices.

[1] Gaupp CL, Reynolds JR, Multichromic copolymers based on 3,6-bis(2-(3,4-ethylene- dioxythiophene))-N-alkyl carbazole derivatives, Macromolecules 36, 6305–6315 (2003).
[2] Dirk Schawaller, Michael Voss, Volker Bauch, Erik Frank, Michael R. Buchmeiser; Flexible, switchable electrochromic textiles, Macromol. Mater. Eng.p. 330–335 (2013)
[3] Abramoff, M.D.; Magalhães, Paulo J.; Ram, Sunanda J., Image processing with ImageJ, Biophotonics international, 11, 36 – 42 (2004)