Preparation and characterization of 3-Mercaptopropyltrimethoxysilane modified viscose coated by copper

Xiaodong Tan[1], Qingyan Peng[1], Jana Saskova[1], Jiri Militky[1]

[1] Department of Material Engineering, Faculty of Textile Engineering, Technical University of Liberec, 461 17 Liberec, Czech Republic, e-mail: xiaodong.tan@tul.cz

Abstract: *In this study, 3-Mercaptopropyltrimethoxysilane (3-MT) was utilized to modify viscose nonwoven fabrics, aiming to improve the copper electroplating procedure. The outcomes indicated that the treated viscose facilitated the adherence of metal particles during the copper electroplating, attributable to the thiol groups' affinity for metals, leading to a nearly complete coverage of the viscose fibers by copper particles. Furthermore, the 3MT@Cu@Viscose composite demonstrated remarkably low surface and bulk resistivity values (346.6 mΩ and 333.2 mΩ·m, respectively), stable Joule heating performance, and superior electromagnetic interference (EMI) shielding effectiveness (over 50 dB). These properties suggest its significant promise for use in versatile electronic devices, including heat-generating sensors, intelligent garments, and barriers for EMI shielding.*

Keywords: *3-Mercaptopropyltrimethoxysilane, Viscose, Copper, Resistivity, EMI shielding.*

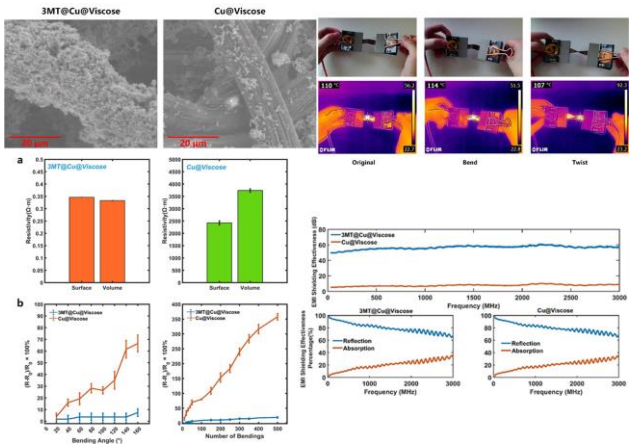

Figure 1 SEM of 3MT@Cu@Viscose and Cu@Viscose; Surface and volume resistivity of Cu@Viscose and 3MT@Cu@Viscose; Relative resistance change as a function of bend angle and the number of bends; Joule heating performance of 3MT@Cu@Viscose in bent and twisted states under 1 V; EMI shielding effectiveness of samples in the 30 MHz–3 GHz band.

ACKNOWLEDGEMENT*: This work was supported by the research project of Student Grant Competition of Technical University of Liberec no. 2024-6449 granted by Ministry of Education Youth and Sports of Czech Republic.*

REFERENCES

[1] Shahabuddin M, Uddin MN, Chowdhury JI, Ahmed SF, Uddin MN, Mofijur M, et al. A review of the recent development, challenges, and opportunities of electronic waste (e-waste). Int J Environ Sci Technol 2022:1–8.

[2] Ilankoon I, Ghorbani Y, Chong MN, Herath G, Moyo T, Petersen J. E-waste in the international context–A review of trade flows, regulations, hazards, waste management strategies and technologies for value recovery. Waste Manag 2018;82:258–75.

[3] Zhao D, Zhu Y, Cheng W, Chen W, Wu Y, Yu H. Cellulose-based flexible functional materials for emerging intelligent electronics. Adv Mater 2021;33:2000619.

[4] Mondin G, Lohe MR, Wisser FM, Grothe J, Mohamed-Noriega N, Leifert A, et al. Electroless copper deposition on (3-mercaptopropyl) triethoxysilane-coated silica and alumina nanoparticles. Electrochim Acta 2013;114:521–6.

[5] Djokić SS. Electroless deposition of metals and alloys. Mod Asp Electrochem 2002:51–133.

[6] Maruthi N, Faisal M, Raghavendra N. Conducting polymer based composites as efficient EMI shielding materials: A comprehensive review and future prospects. Synth Met 2021;272:116664.

[7] Jia X, Li Y, Shen B, Zheng W. Evaluation, fabrication and dynamic performance regulation of green EMI-shielding materials with low reflectivity: A review. Compos Part B Eng 2022:109652.