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Abstract

Impact of Poly(3-hexylthiophene) Chains Length and Other Applied Side-Chains on the Sensitivity of Gas Sensors Based on Conducting Graft Copolymers †

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In this work, novel conducting graft copolymers: DodecSil (Poly(dimetylesiloksane)-co-[poly(metylhydrosiloksane)-graft-2-winyl-poly(3-heksylthiophene)]-co-[poly(dimetylsiloksane)-graft-dodec-1-en]) and PEGSil (Poly(dimetylsiloksan)-co-[poli(metylohydrosiloksane)-graft-2-winyl-poly(3-heksylthiophene)]-co-[poly(dimetylsiloksane)-graft-metakrylane ethere metylene poly (etylene glicole)]) were tested as gas receptor thin films in resistance gas sensors. For both graft copolymers, two variants were tested: fractions with shorter (hexane fraction-H) and longer (chloroform fraction-CH) side-chains of P3HT. Sensors were obtained using the spin coating method on interdigital transducers (Au on Si/SiO_2). Sensor responses to NO_2 (1–20 ppm) were tested and compared. Experiments were carried out in the dry nitrogen atmosphere at different operating temperatures (room temperature (RT), 50 °C and 100 °C). Results showed that both copolymers with PEG side-chines had higher response to NO_2 than materials with dodec-1-en side-chains. What is more, results showed that in both cases hexane fractions are more sensitive than chloroform fractions. Measured responses ($R_a/R_g \cdot 100\%$) to 1 ppm of NO_2 at RT are: 250% DodecSIL-CH, 460% DodecSIL-H, 600% PEGSil-Ch and 1330% PEGSil-H. Similarly, in other operating temperatures, PEGSil film responses were higher than DodecSil ones, and H fractions were more sensitive than CH fractions. This showed that graft copolymers of P3HT have a huge potential for low temperature NO_2 sensing, and the proper choice of other side-chains can improve their sensing properties.

Conflicts of Interest: The authors declare no conflict of interest.