

Turkish Journal of Chemistry

Turkish Journal

of

Chemistry

DC Conduction in Electrochemically Synthesized Polypyrrole Films

Akif KAYNAK

Department of Engineering Sciences,
Middle East Technical University,
06531 Ankara - TURKEY

 [Keywords](#)
 [Authors](#)



chem@tubitak.gov.tr

[Scientific Journals Home
Page](#)

Abstract: DC conductivity measurements were performed by modified four-probe rig on electrochemically synthesized polypyrrole films at a temperature range of -30°C to 120°C. Conductivity increased with temperature. The temperature dependence of conductivity was very high for lightly doped polymers, decreasing as the doping level increased. The model used to describe the conduction process was the conduction model originally developed for amorphous silicon by Mott and Davis. When applied to conducting polymers, it assumes that electron transport originates from localized or fixed states within the polymer chain. The charge transfer between the chains takes place by hopping, referred to as phonon-assisted hopping, between two localized states. Plots of DC conductivity versus temperature can be parametrized by Mott's Variable Range Hopping conduction model. The DC conductivity of polypyrrole films doped from light to intermediate levels with p-toluene sulphonic acid were measured in the temperature range of 77K to 300K. The localization length of localized electrons was assumed to be 3 Å, which is approximately equal to the length of the pyrrole monomer. Mott parameters of polypyrrole films doped with p-TS were evaluated at 300K and 10K. Results were found to be consistent with the Mott's requirement that $\alpha R \gg 1$. Theoretical values of α and $N(E_F)$ have been determined at approximately 10^8 cm^{-1} and $10^{19}\text{-}10^{20} \text{ cm}^{-3} \text{ eV}^{-1}$, respectively. Hence according to Mott parameters determined by the experimental data for the p-TS doped polypyrrole samples, Mott parameters are seen to have a better agreement with those expected from disordered systems, particularly for lightly doped samples, indicating the suitability of Mott's model to these samples. The average hopping distance R decreased from 16 Å to 4.4 Å with the increase in the doping level from 0.006 M to 0.03 M at 300K, whereas at 10K, R decreased from 37 Å to 10 Å over the same dopant range.

Turk. J. Chem., **22**, (1998), 81-86.

Full text: [pdf](#)

Other articles published in the same issue: [Turk. J. Chem., vol.22, iss.1.](#)