# Electrochemical Study of Polypyrrole Coated Electrospun Polycaprolactone Nanofibers and Their Potential Application in Biosensors

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Biosensor designs which consistent of a bio-receptor and a transducer components [1] are emerging at a significant rate since they are rapid, simple and inexpensive analytical tools for detection of certain analyte [2]. Conductive polymers (CPs), such as polypyrrole (PPy), have been extensively used as transducer in biosensors. CPs exhibit interesting and promising electrical properties such as relatively high conductivity and good environmental stability [3]. By the immobilization of biomolecules on surfaces it is possible to develop biologically functionalized materials as biosensors [4]. In this study, Pyrrole (Py) was polymerized on Polycaprolactone (PCL) nanofibers as electrochemical transducer surface were characterized via electrochemical impedance spectroscopy (EIS).

PCL nanofibers were fabricated by elecrospinning technique. PPy was polymerized on electrospun PCL nanofibers by in-situ polymerization with $Fe3^{+}$ as an oxidant and $Cl^{-}$ as a dopant. The calf thymus single-stranded DNA (ssDNA) was immobilized on the PPy coated PCL nanofibers. Surface morphologies of nanofibers were analysed by SEM (Figure 1). The structural properties of PCL, PCL-PPy and ssDNA immobilized PCL-PPy nanofibers were investigated by using an FTIR-ATR spectrophotometer (Figure 2). EIS measurements and equivalent circuit fitting were performed (Figure 3, Table 1).

PPy coated PCL nanofiber mat exhibited nearly ideal capacitor feature. This is a promising structure which can be used for electrochemical DNA biosensor applications with the further optimizations.

**References**

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[3] M. I. Rodríguez and E. C. Alocilja, IEEE Sensors Journal, 2005, 5, 4, 733.
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**Figures**

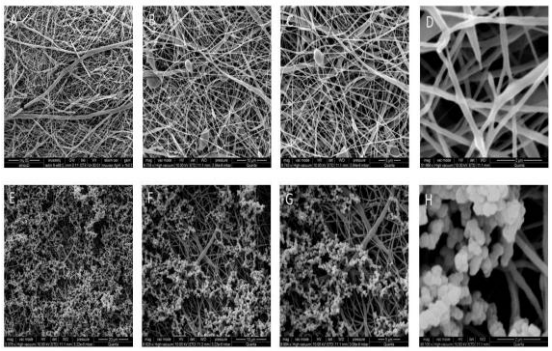



**Figure 1.** SEM images of nanofibers. A,B,C,D show PCL nanofibers; E,F,G,H indicate PPy coated PCL electropun nanofibers. The images have 20,10,5 and 2 μm scale bars in order left to right.

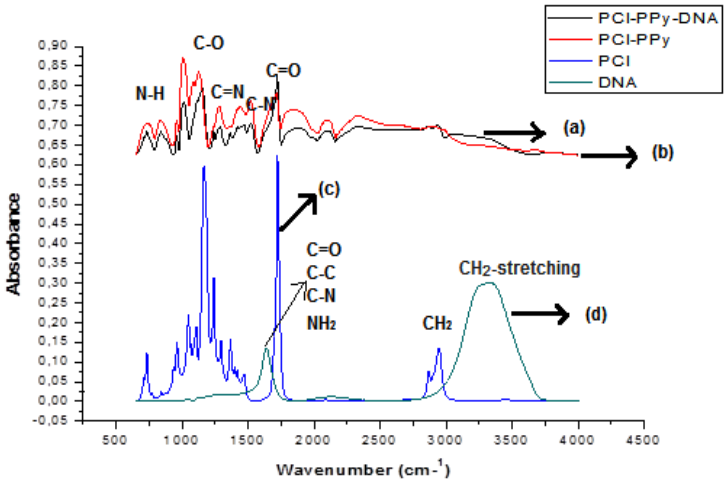



**Figure 2.** FT-IR-ATR spectra of PCL, PCL-PPy and PCL-PPy-DNA nanofibers. The spectra presents (a) calf thymus DNA(10μM) immobilized on PPy coated PCL nanofibers (b) PPy coated PCL nanofibers (c) PCL nanofibers (d) Single Stranded calf thymus DNA.

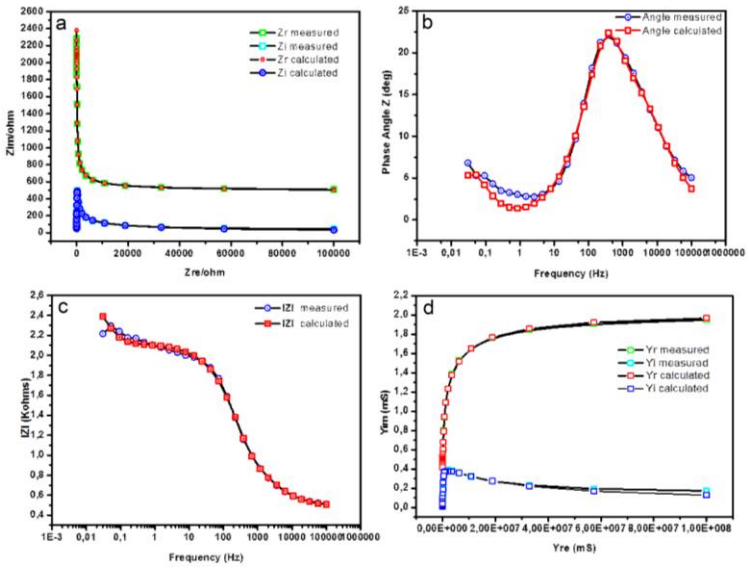
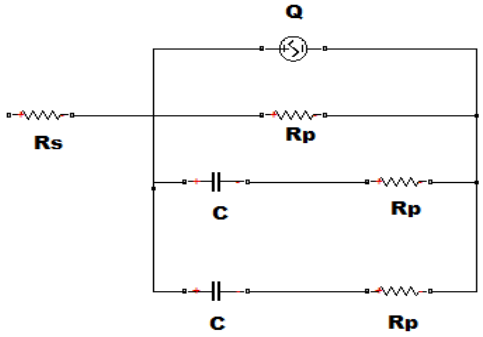



**Figure 3.** Equivalent circuit modeling of DNA immobilized PCL-PPy. Nyquist (a), Bode phase (b), Bode magnitude (c) and Admittance (d) plots of PCL-PPy-DNA nanofibers.

**Table 1.** Equivalent circuit components for simulating the impedance spectra. Inset: R(Q(R)(CR)(CR)).

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|---|---|
| **Rs** | 638.8 Ohmxcm$^2$ |
| **CPE** | 2.825 $10^{-6}$ Sxsec$^n$/ cm2 |
| **R** | 2.712 $10^9$ |
| **C** | 1.821 $10^{-5}$ F/cm2 |
| **R** | 1.823 $10^5$ |
| **C** | 0.02123 F/cm2 |
| **R** | 2233 |