# Electrochemical Properties of Polytetrafluoroethylene (PTFE) Encapsulated in Polyvinylalcohol (PVA) Nanofibers and Their Supercapacitor Application

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Polytetrafluoroethylene (PTFE) nanofibers had received much attention due to their wide range of applications including in tissue engineering, drug delivery, cancer diagnosis, energy storage systems, optical sensors, along with water and air filtration [1-2]. Many different polymers have been mixed with PTFE to take advantage of its high resistance to chemicals and moisture, non-flammability, and non-stickiness. Yet, with a slippery surface, it does not stick and removes external factors easily [3].

This work investigates the effect of different combinations of polymers with PTFE for nanofiber materials to be applied as electrodes in supercapacitors application. The prepared materials using the optimized condition produced smooth scaffolds nanofibers between 55-200 nm range of sizes.

The best $C_{sp}$ value was obtained from a mixture of PTFE-PVA. Different scan rates were applied to the sample in the interval of 5, 20, 50 100, and 250 $mVsec^{-1}$. The best $C_s$ value was obtained from 100 $mVsec^{-1}$ as 202.45 $Fg^{-1}$. Then, long-term charge-discharge measurements were applied with a 100 $mVsec^{-1}$ up to 200 cycles and $C_s$ value remain the same ( no percentage enhancement between the first and last cycle). This shows that the stability of the developed supercapacitor is acceptable up to 200 cycles. However, the $C_s$ value of this sample is higher than 200 $C_s$ and it is comparable with reported electrodes in the literature, therefore, the PTFE-PVA combination has the potential as energy storage material.

Table 1. Table of $C_s$ value of PTFE-PVA nanofibers at different scan rates.

| Scan rate/ $mVsec^{-1}$ | $C_s$/ $Fg^{-1}$ |
|---|---|
| 5 | 3.555654497 |
| 20 | 2.778272484 |
| 50 | 6.300089047 |
| 100 | 202.4487979 |
| 250 | 41.58504007 |

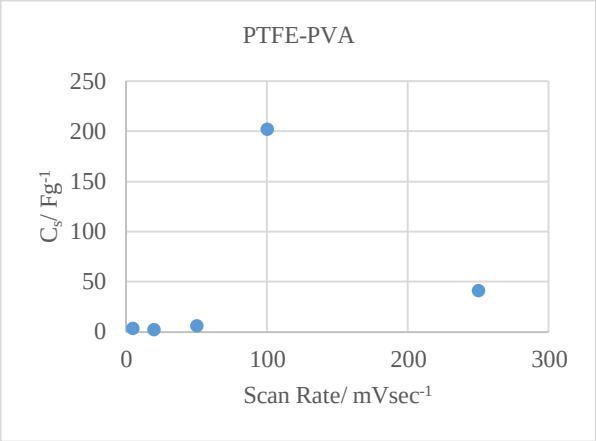


Figure 1. The $C_s$ value plot of PTFE-PVA nanofibers at different scan rates.

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**References**

[1] C. K. Hwang, K. A. Lee, J. Lee, Y. Kim, H. Ahn, W. Hwang, B. K. Ju, J. Y. Kim, S. Y. Yeo, J. C., Y. E.Sung, I. D. Kim, K. R. Yoon. Nano Energy, 101 (2022) 107581.
[2] H. Xu, W. Jin, F. Wang, G. Liu, C. Li, J. Wang, H. Zhu and Y. Guo. RSC Advances, 9 (2019) 13631-13645
[3] Feng, S., Zhong, Z., Wang, Y., Xing, W. ve Drioli, E. (2018). *549* (2017), 332-349.

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