Development of Metal Organic Framework Modified Carbon Paste Electrode for Supercapacitor Applications

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Metal–organic framework (MOF) is a comparatively novel group of attractive materials for specific electrochemical sensing because of its electrocatalytic activity and large surface area. [1]. They have been combined with carbon paste electrodes (CPE) for electrochemical studies and electroanalysis, however, their applications in energy storage devices are limited and not widely reported [2].

Therefore, our research focus on modified CPE in combination with MOFs; UiO-66 and MOF-199. The UiO-66/CPE electrode was prepared by mixing 80% graphite powder with 20% mineral oil and 15% of UiO-66 and MOF-199/CPE electrode was prepared by mixing 80% graphite powder with 20% mineral oil and 5% MOF-199 respectively. As a result; two nanostructure-modified electrodes were obtained.

Different scan rates were applied to both nanostructure-modified electrodes; in the interval of 5, 20, 50 100, and 250 $mVsec^{-1,}$ and the best C_s value was obtained from 100 $mVsec^{-1}$ with 47.5 and 104.1 Fg^{-1} respectively. Then, long-term charge-discharge measurements were applied with a 100 $mVsec^{-1}$ up to 200 cycles and C_s value reached 69.4 and 48.3 Fg^{-1} respectively. We conclude that MOFs composites seem to be the best electrodes for supercapacitor applications.

Table 1. Table of C_s value of MOFs/CPE electrodes at different scan rates.

Scan rate/ $mVsec^{-1}$	**C_s/ Fg^{-1}**	
	UiO66/CPE	MOF199/CPE
5	7.824	25.46
20	7.355	19.5
50	14.9	37.18
100	47.5	104.1
250	9.12	18.92

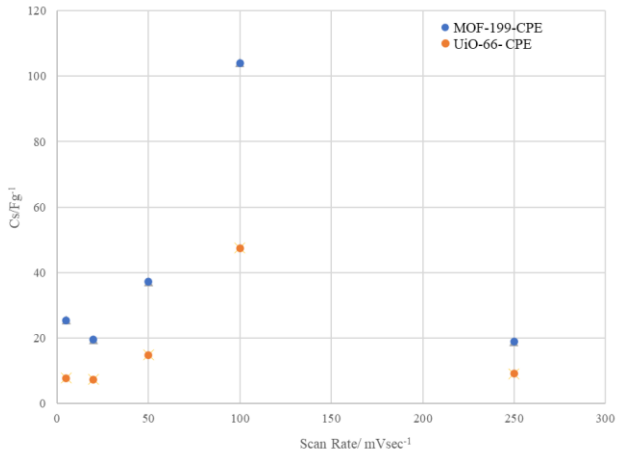

Figure 1. The plot of C_s value of MOFs/CPE electrodes at different scan rates.

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References

[1] L. Wu, Z. W. Lu, Y. Ma, J. J. Zhang, G. Q. Mo, H. J. Du, J. S. Ye. Chinese Journal of Analytical Chemistry, 48 (2020) e20038-e20046

[2] Y. Wang, Y. Wu, J. Xie, X. Hu. Sensors and Actuators B: Chemical, 177 (2013) 1161-1166

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