

## SIIC070

### EXPLORING THE PARAMETER FOR ALTERNATING CURRENT ELECTROPHORETIC DEPOSITION OF CARBON NANOTUBES-POLYPYRROLE : A REVIEW

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#### **Abstract:**

Carbon nanotubes (CNTs) is one of the most widely used carbonaceous materials aside from graphene and activated carbon. Electrophoretic deposition (EPD) of CNTs, especially in combination with polypyrrole (PPy), is receiving increasing attention from medical field and also electric and electronic field. This review has discussed key published work on factors related to the operation of AC-EPD and factors related to suspension of CNTs-PPy film formation. It has been shown that AC-EPD techniques can be used to obtain smooth and low bubble formation of film deposited on substrate electrode at high voltages from aqueous suspensions. This research paper was completed by the systematic review from previous journals method. The review was limited to studies published in 20 years back to see the evolution of EPD technique. For the factors related to operation, the wave frequency should be at the range of 0.01 Hz to 1 kHz by using sinusoidal wave. The deposition period is 4 minutes to 110 minutes depends on the wave frequency, waveform and the peak to peak voltage. Duty cycle for rectangular wave is 80%. The optimum range of peak to peak voltage is 16 V to 100 V. For factors related to suspension, the suggested medium of suspension is acetone and dispersing agent for CNTS-PPy composites is malachite green.

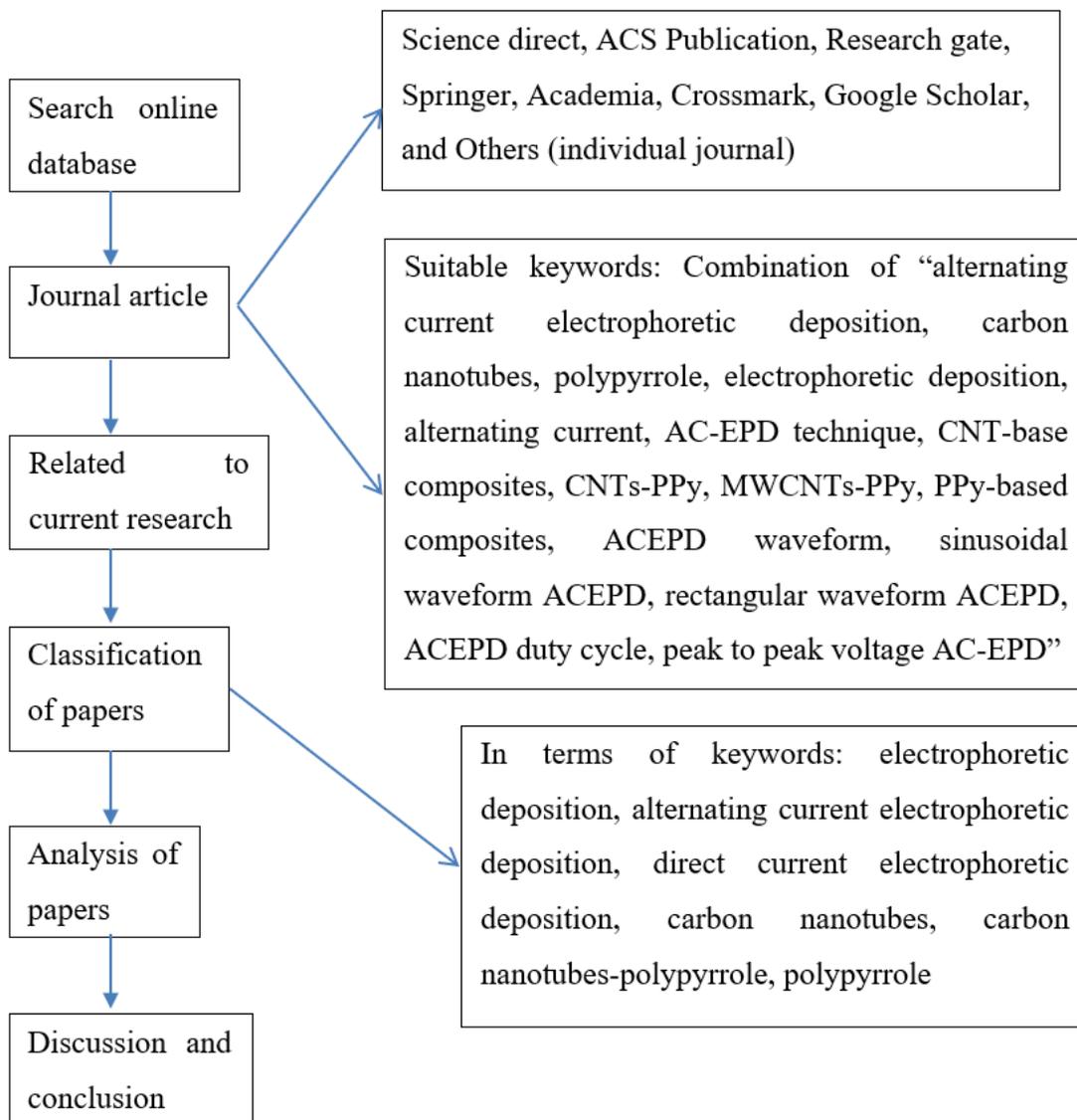
#### **Keywords:**

alternating current electrophoretic deposition; carbon nanotubes; polypyrrole; parameter; suspension

#### **Objectives:**

The objective of the study is to determine the important parameter for AC-EPD of CNTs-PPy.

**Methodology:**



**Results:**

AC-EPD parameter							
Electrode material	Inter-electrode distance, mm	Wave frequency, Hz	Period of deposition, Min	Duty cycle, %	Waveform	Peak to peak voltage, V	Ref.
Stainless steel	10	1000	10	80	Rectangular	10	[51]
Stainless steel	10	25	10	-	Triangular	50	[52]
Stainless steel	10	25	10	-	Triangular	100	[52]
Nickel	10	1000	5	-	Rectangular	16	[53]
Gold coated glass	-	10	110	-	Sinusoidal, rectangular, and triangular	-	[54]
Gold	-	1000	10	-	-	-	[55]
Gold coated glass	-	1M	-	-	Sinusoidal	-	[56]
Copper foil	-	50	30	-	-	-	[57]
Gold	-	1M	-	-	-	16	[58]

**Conclusion:**

This review has discussed key published work on factors related to the operation of AC-EPD and factors related to suspension of CNTs-PPy film formation. It has been shown that AC-EPD techniques can be used to obtain smooth and low bubble formation of film deposited on substrate electrode at high voltages from aqueous suspensions. For the factors related to operation, the wave frequency should be at the range of 0.01Hz to 1 kHz by using sinusoidal wave. However, rectangular waveform was also one of the best choice due to its performance at low frequency which were able to obtain high yield deposits. The deposition period, as from Table 4.1, is 4 minutes to 110 minutes depends on the wave frequency, waveform and the peak to peak voltage. For duty cycle as extracted from the literature in Table 4.1, the duty cycle for rectangular wave is 80% in most cases and no duty cycle range for sinusoidal waveform. As from Table 4.1 the optimum range of peak to peak voltage is 16 V to 100 V. it is said to be optimum due to the deposition rate will decrease at the peak to peak voltage of more than 400 V. For factors related to suspension, the suggested medium of suspension is acetone and it was discovered that acetone was the popular suspension medium amid the electrode material of MWCNTs due to the low viscosity in acetone which is a desired property in suspension. In dispersing CNTS-PPy composites, malachite green is one of the best dispersing agent for CNTs-PPy composites dispersion as it shows higher capacitance for electrochemical supercapacitor electrode.