Electronic Supplementary Information (ESI)

Heterostructured poly(3,6-dithien-2-yl-9H-carbazol-9-yl acetic acid)/TiO_2 nanoparticles composite redox-active materials as both anode and cathode for high-performance symmetric supercapacitor applications

Deniz Yiğit,[a] Mustafa Güllü,*[a] Tuğrul Yumak,[a] and Ali Sınağ[a]

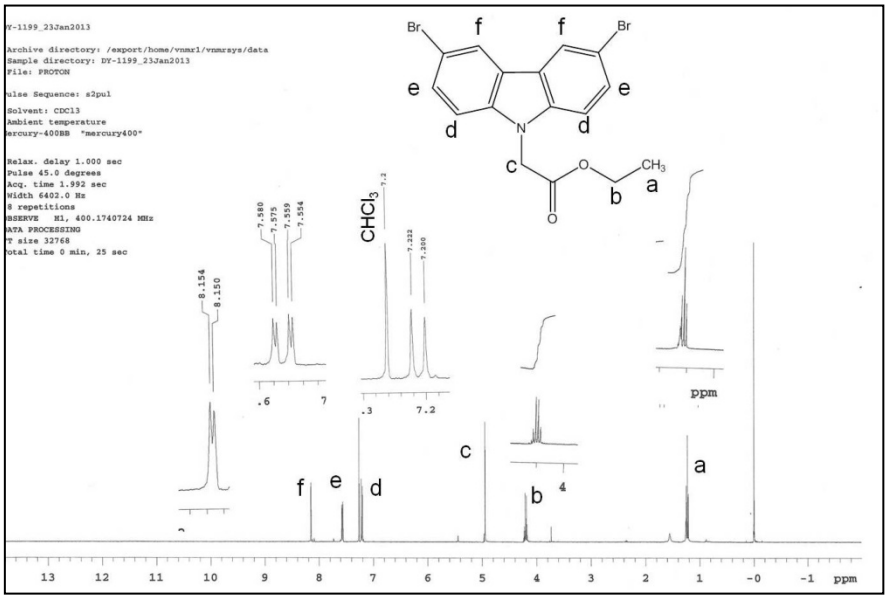


Fig. S1 [1]H NMR spectrum of ethyl (3,6-dibromo-9H-carbazol-9-yl)acetate **(2a)**

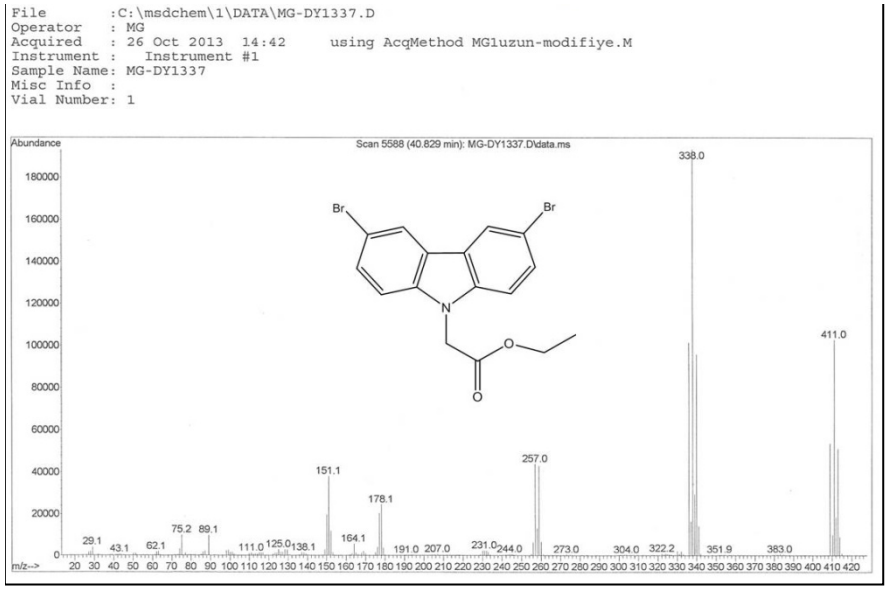


Fig. S2 Mass spectrum of ethyl (3,6-dibromo-9H-carbazol-9-yl)acetate **(2a)**

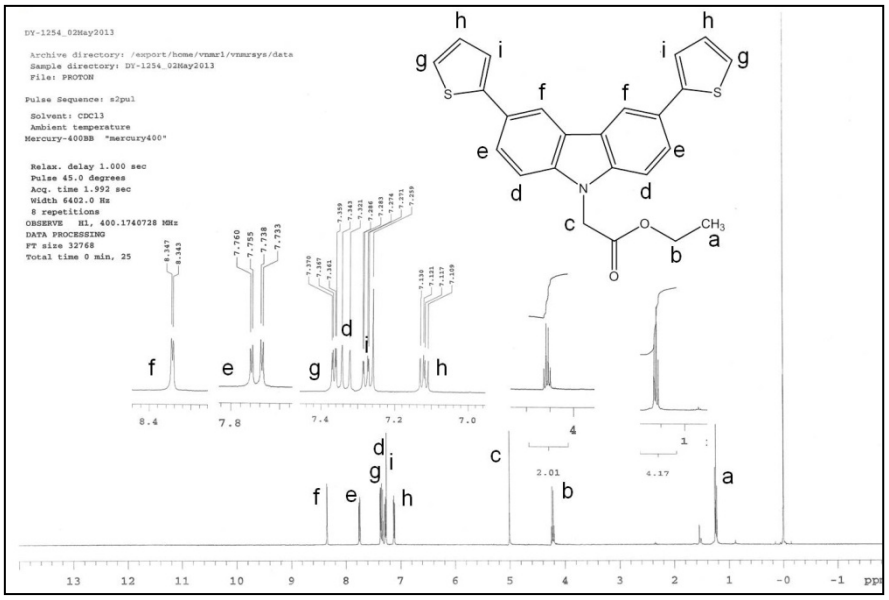


Fig. S3 ^{1}H NMR spectrum of ethyl (3,6-dithien-2-yl-9H-carbazol-9-yl)acetate **(3a)**

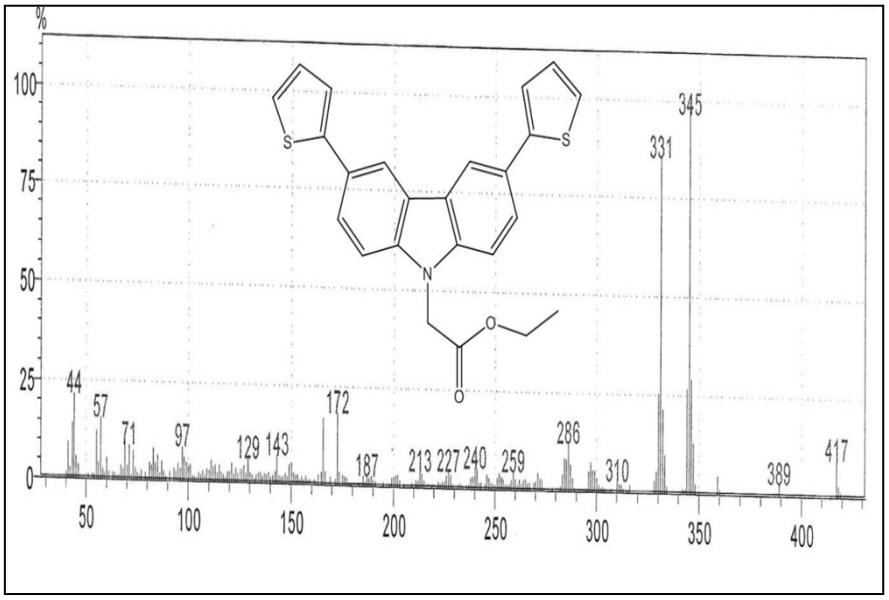


Fig. S4 Mass spectrum of ethyl (3,6-dithien-2-yl-9H-carbazol-9-yl)acetate **(3a)**

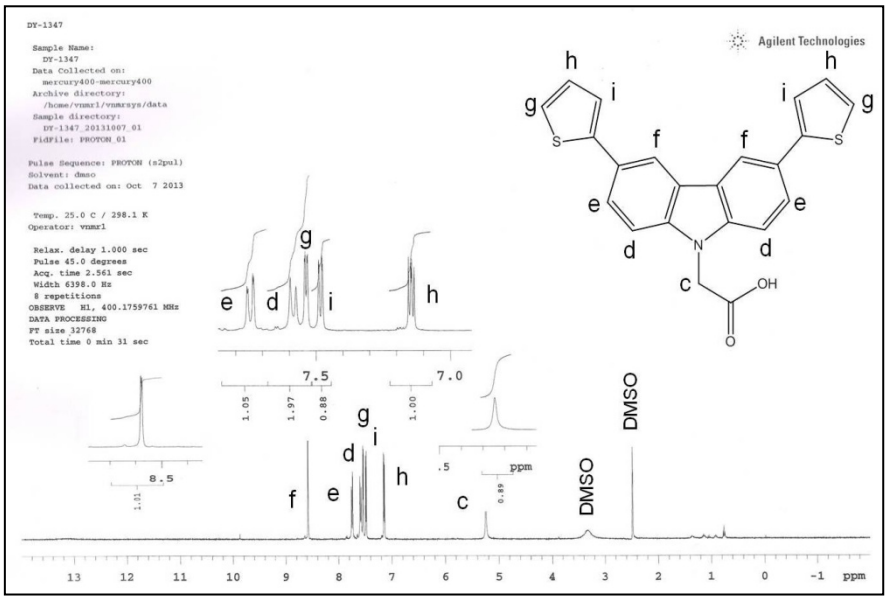


Fig. S5 ^{1}H NMR spectrum of 3,6-Dithien-2-yl-9H-carbazol-9-yl acetic acid **(TCAA)**

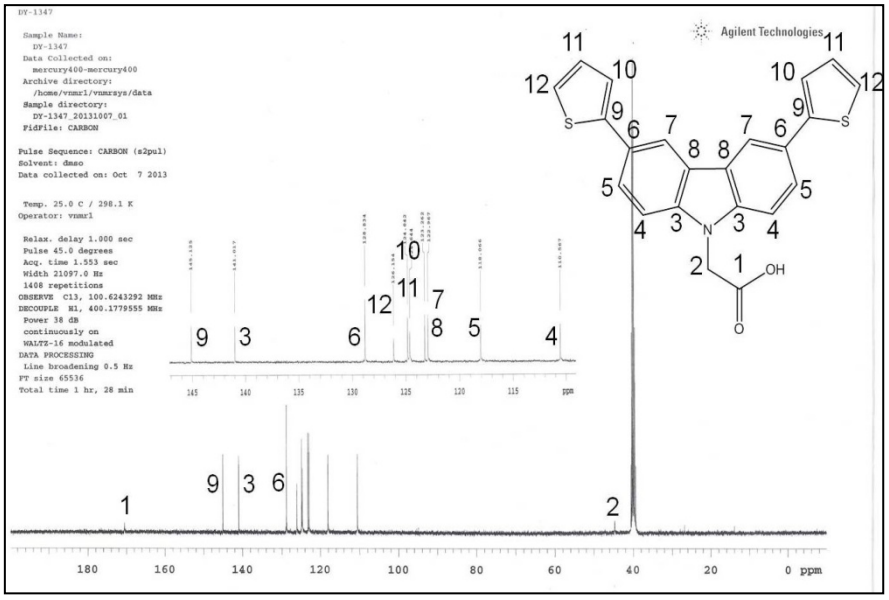


Fig. S6 ^{13}C NMR spectrum of 3,6-Dithien-2-yl-9H-carbazol-9-yl acetic acid **(TCAA)**

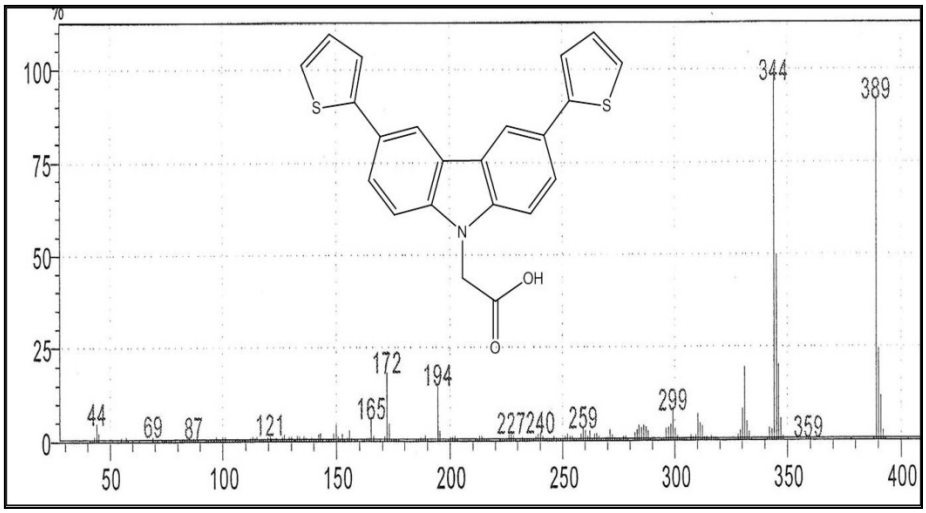


Fig. S7 Mass spectrum of 3,6-Dithien-2-yl-9H-carbazol-9-yl acetic acid **(TCAA)**

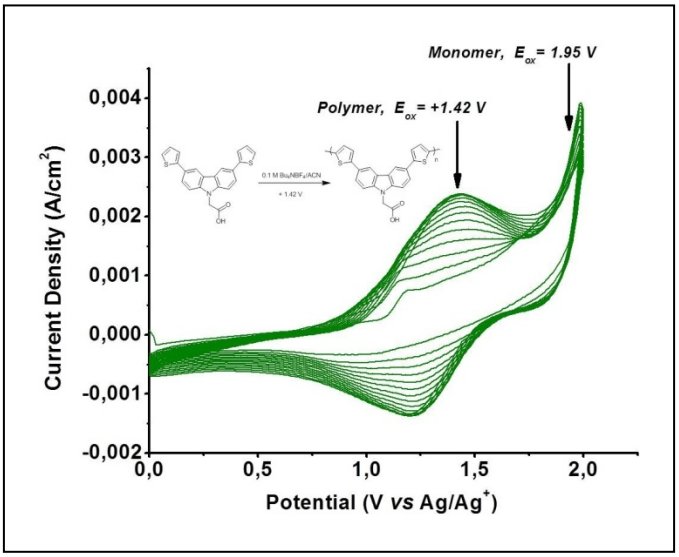


Fig. S8 Cyclic voltammogram of TCAA in 0.1 M Bu_4NF_4/ACN at a scan rate of 150 mV s^{-1}

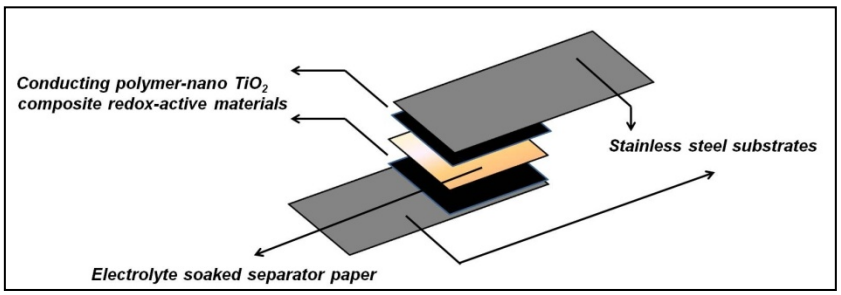


Fig. S9 Schematic representation of the symmetric pseudo-capacitor device

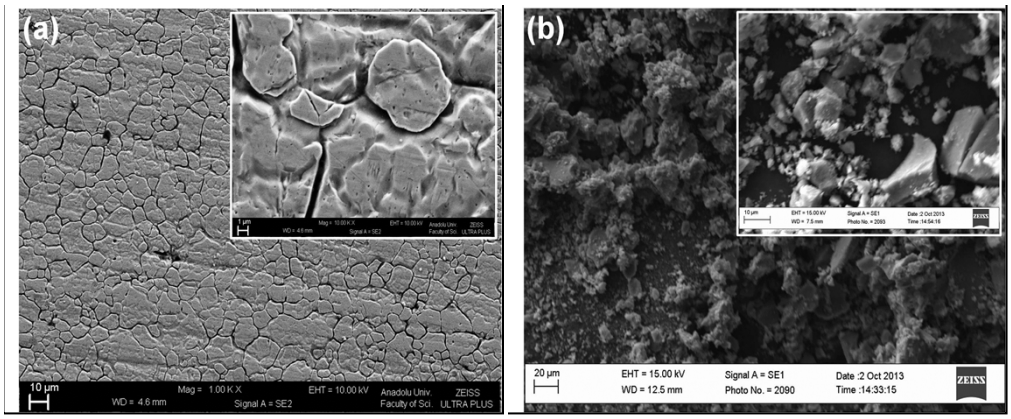
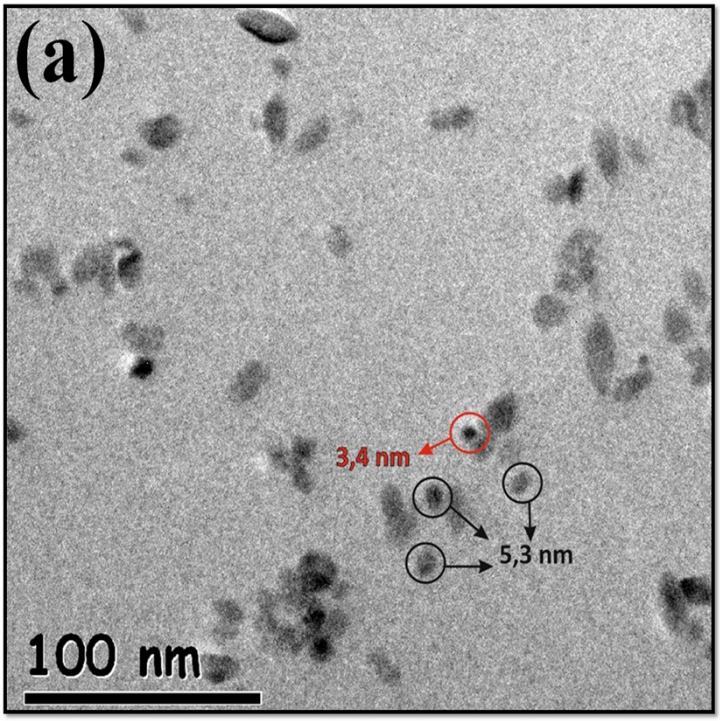
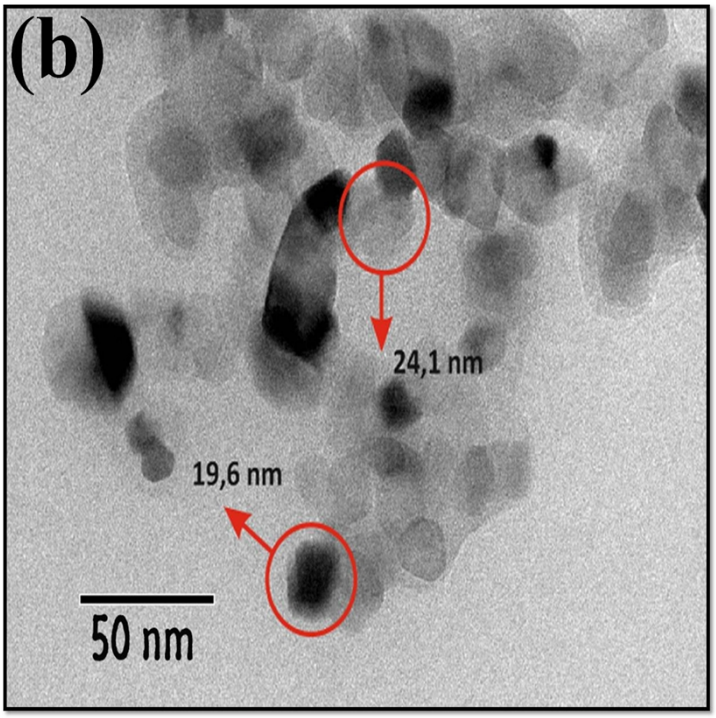


Fig. S10 SEM images of (a) raw stainless steel substrate (b) 3-5 nm sized TiO_2 nanoparticles


(a)
3,4 nm
5,3 nm
100 nm


(b)
24,1 nm
19,6 nm
50 nm

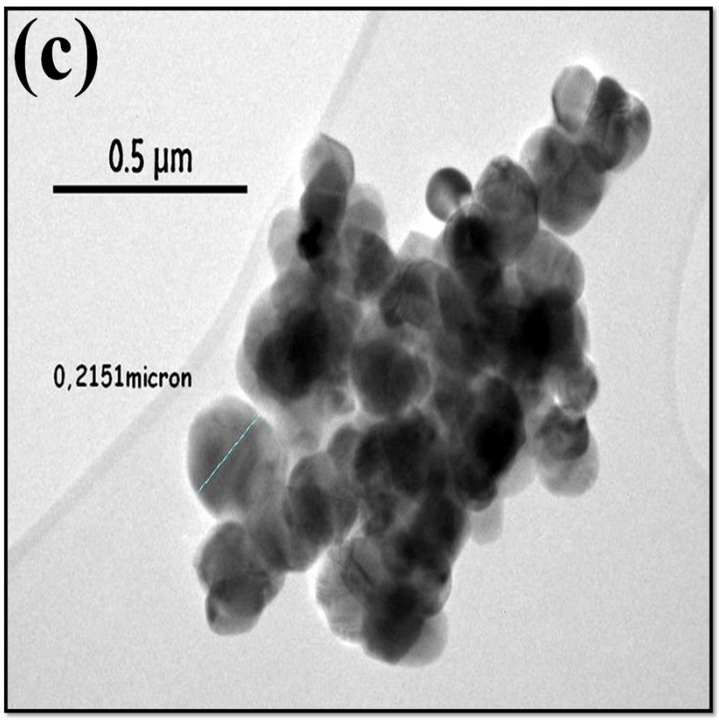


Fig. S11 TEM images of (a) 3-5 nm sized TiO_2 nanoparticles (b) 21 nm sized TiO_2 nanoparticles and (c) bulk TiO_2 particles

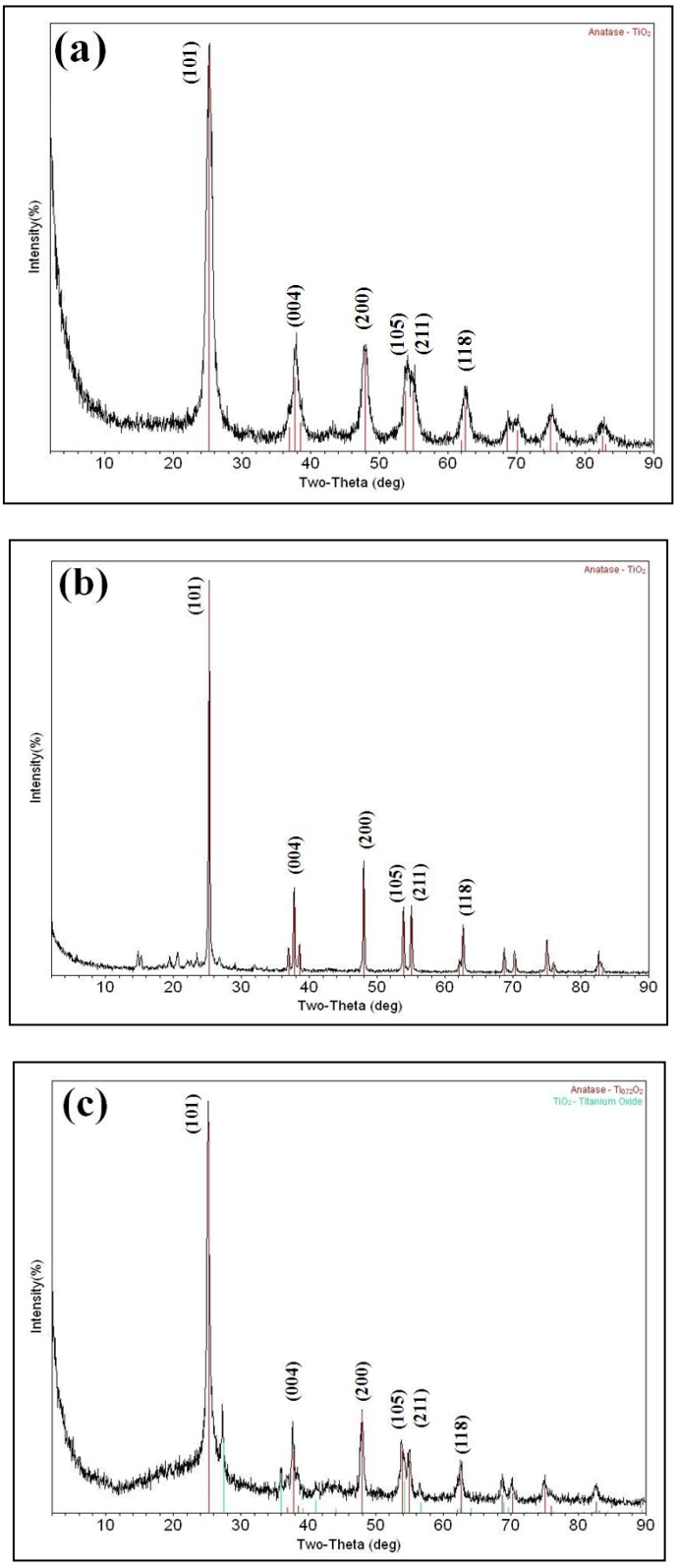


Fig. S12 XRD patterns of the hetereostructured (a) pTCAA/TiO_2 (3-5 nm sized) (b) pTCAA/TiO_2 (21 nm sized) (c) pTCAA/TiO_2 (bulk)

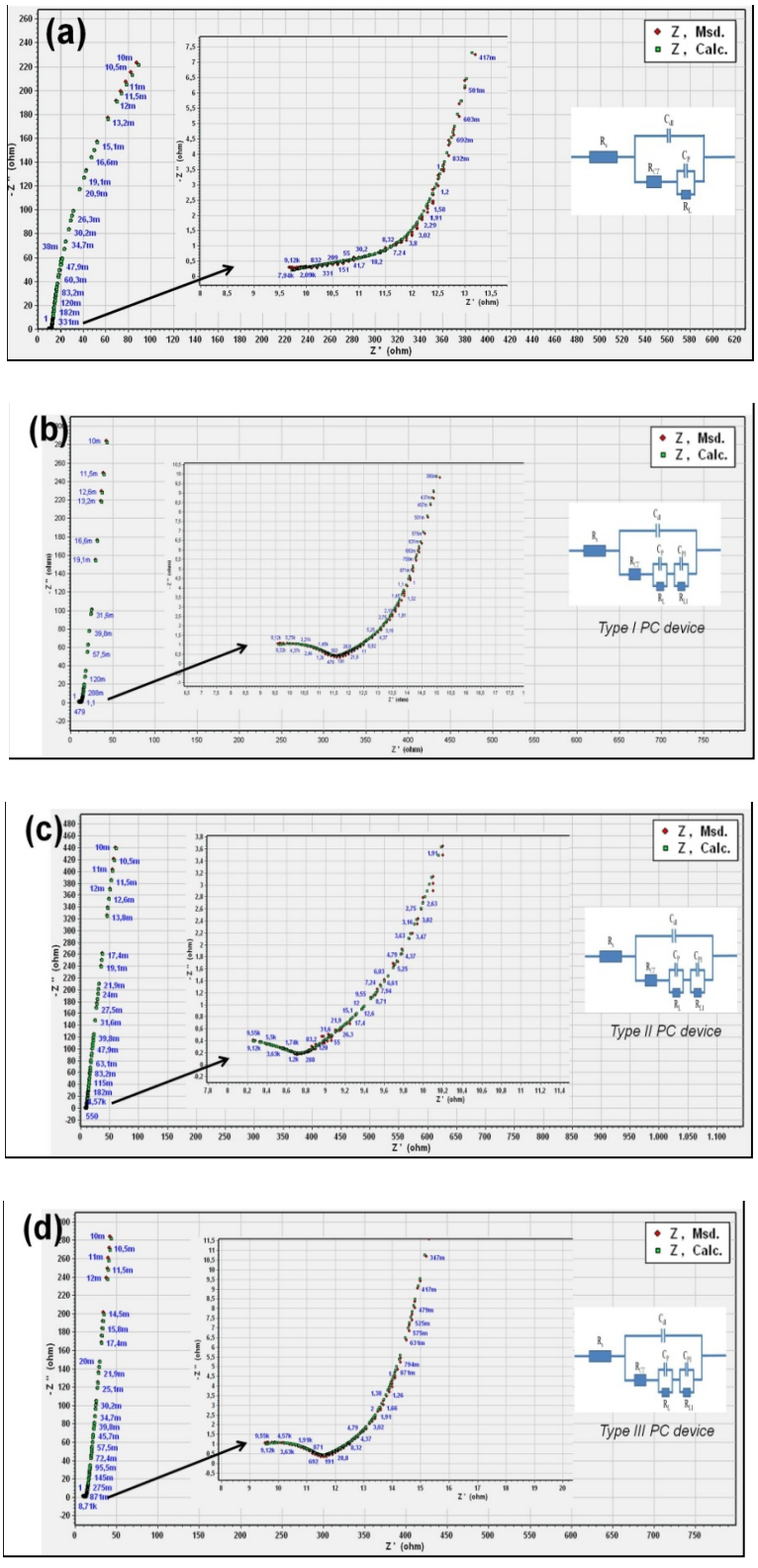


Fig. S13 Theoretical equivalent circuit modelling of (a) *Type IV* reference PC device (b) *Type I* PC device (c) *Type II* PC device (d) *Type III* PC device