

Supporting Information

## **Sulfur/Carbon Cathode Material Chemistry and Morphology Optimisation for Lithium-Sulfur Batteries**

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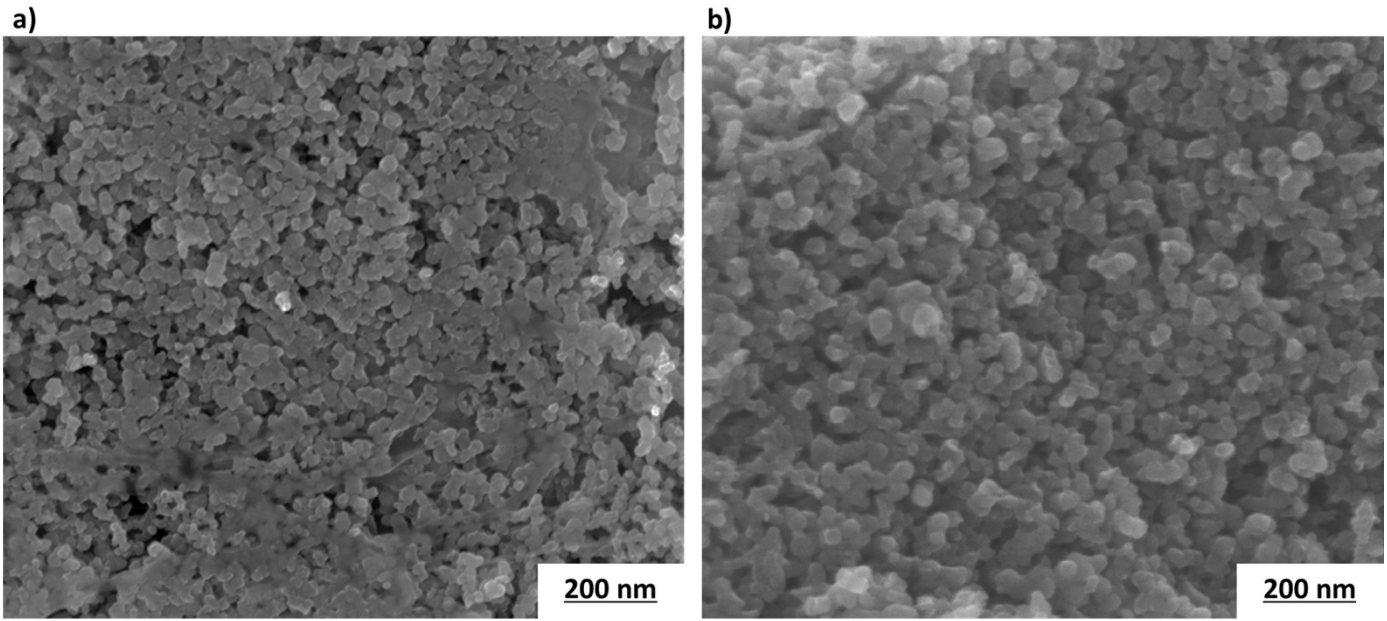


Figure S1. : a) TC10.5 cathode surface SEM image at 200nm; b) TC10.5 S/C composite powder surface SEM at 200nm

Sample	Mass concentration % ( $\pm 40 - 60\%$ )	Atomic concentration % ( $\pm 40 - 60\%$ )	Mass concentration % ( $\pm 53 - 60\%$ )	Atomic concentration % ( $\pm 53 - 60\%$ )
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	Sulfur		Carbon	
<b>SC10</b>	35.4	17.0	64.6	83.0
<b>SC30</b>	26.9	12.1	73.1	87.9
<b>SC50</b>	23.1	10.1	76.9	89.9
<b>SC70</b>	34.4	16.4	65.6	83.6
<b>SC90</b>	35.7	17.2	64.3	82.8

**Table ST1:** EDX atomic and mass % across different cathode samples

## BET Isotherms

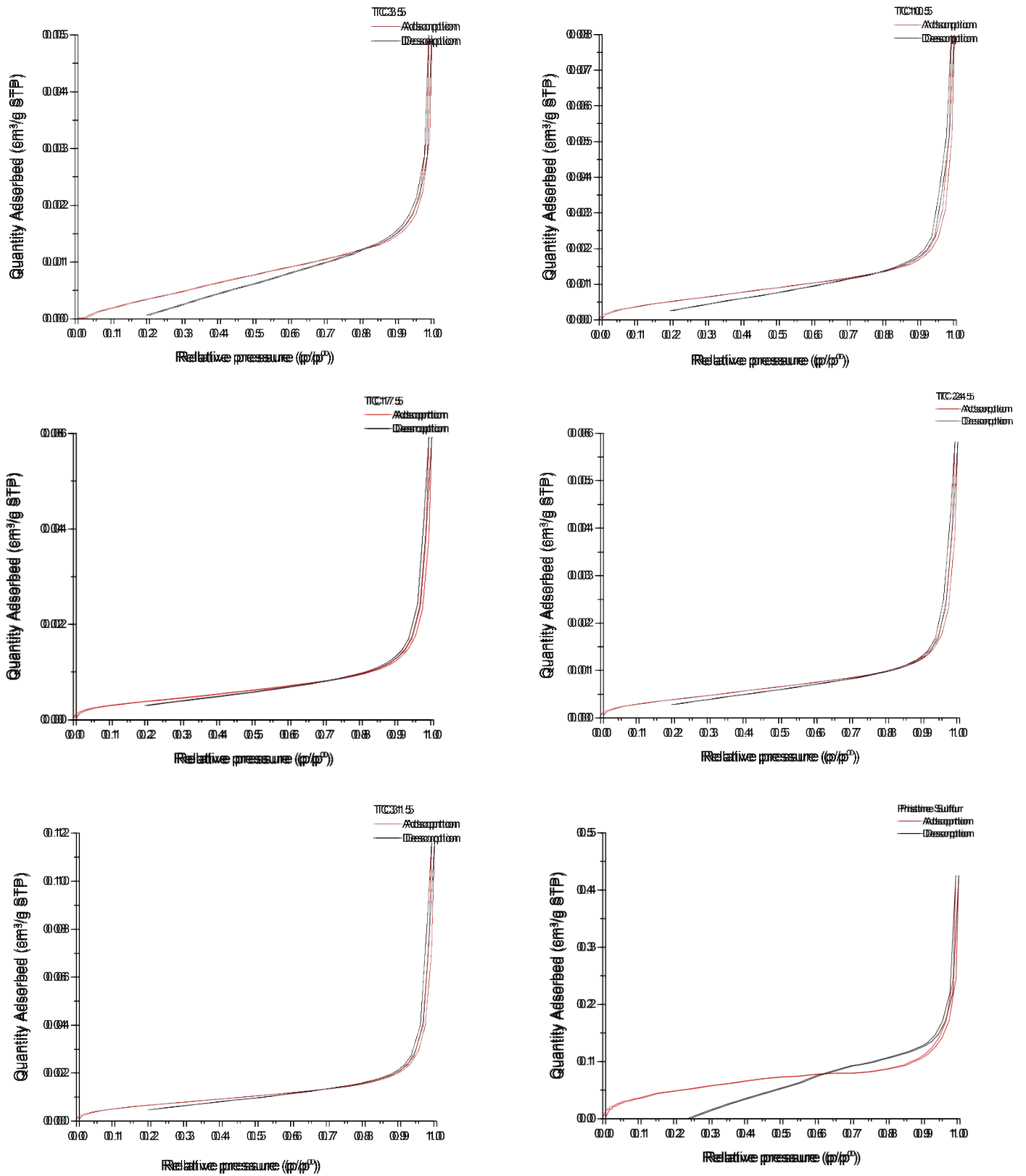


Figure S2: Adsorption and desorption isotherms for all TC sample and pristine sulfur

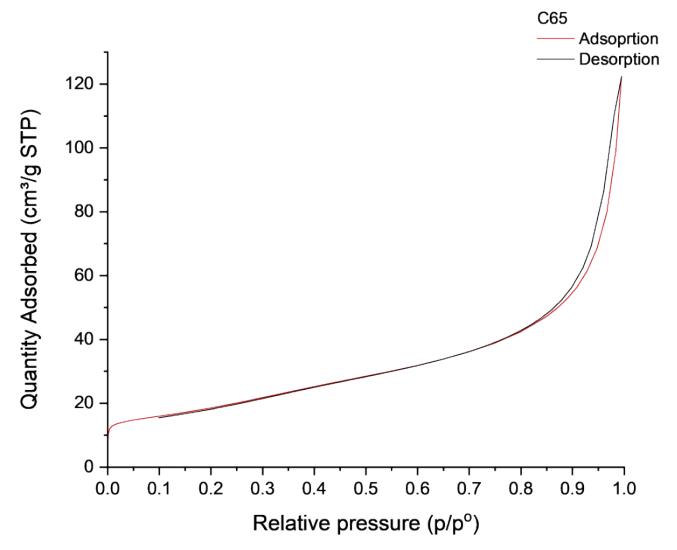
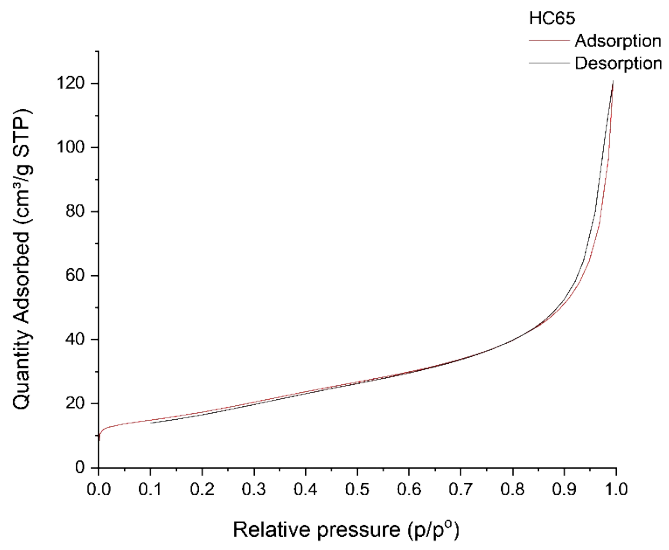


Figure S3: Adsorption and desorption isotherm for heated C65 and pristine C65

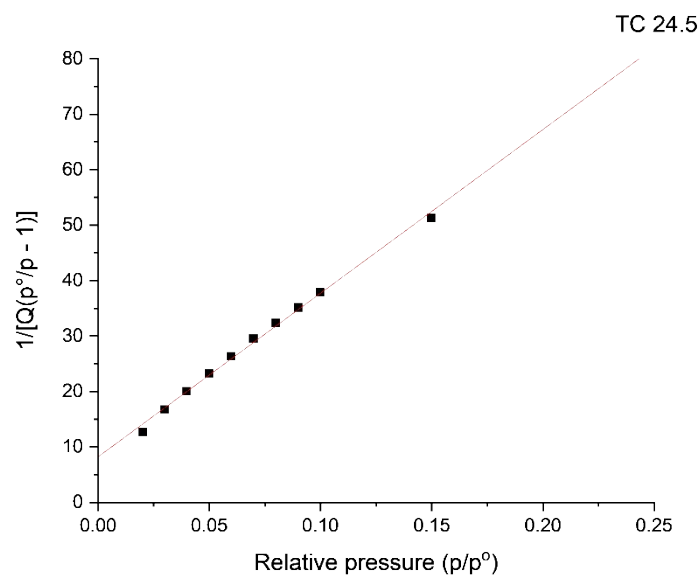
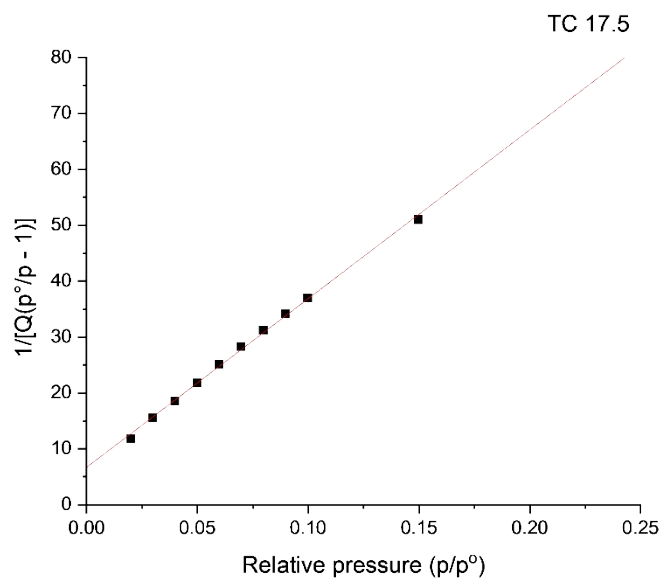
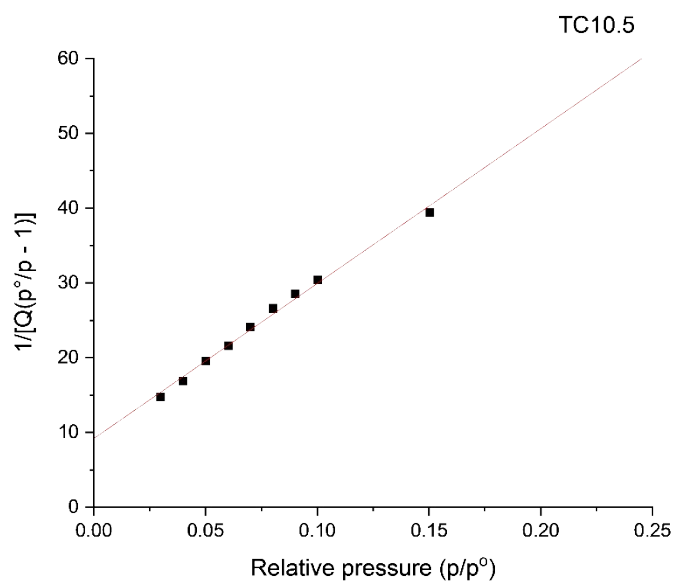
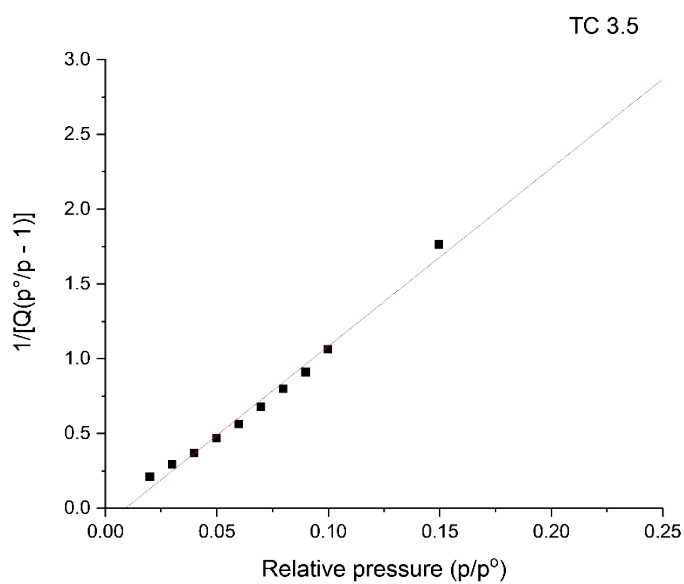


Figure S4: BET surface area plots for TC3.5, 10.5, 17.5 and 24.5

**BET surface area plot**

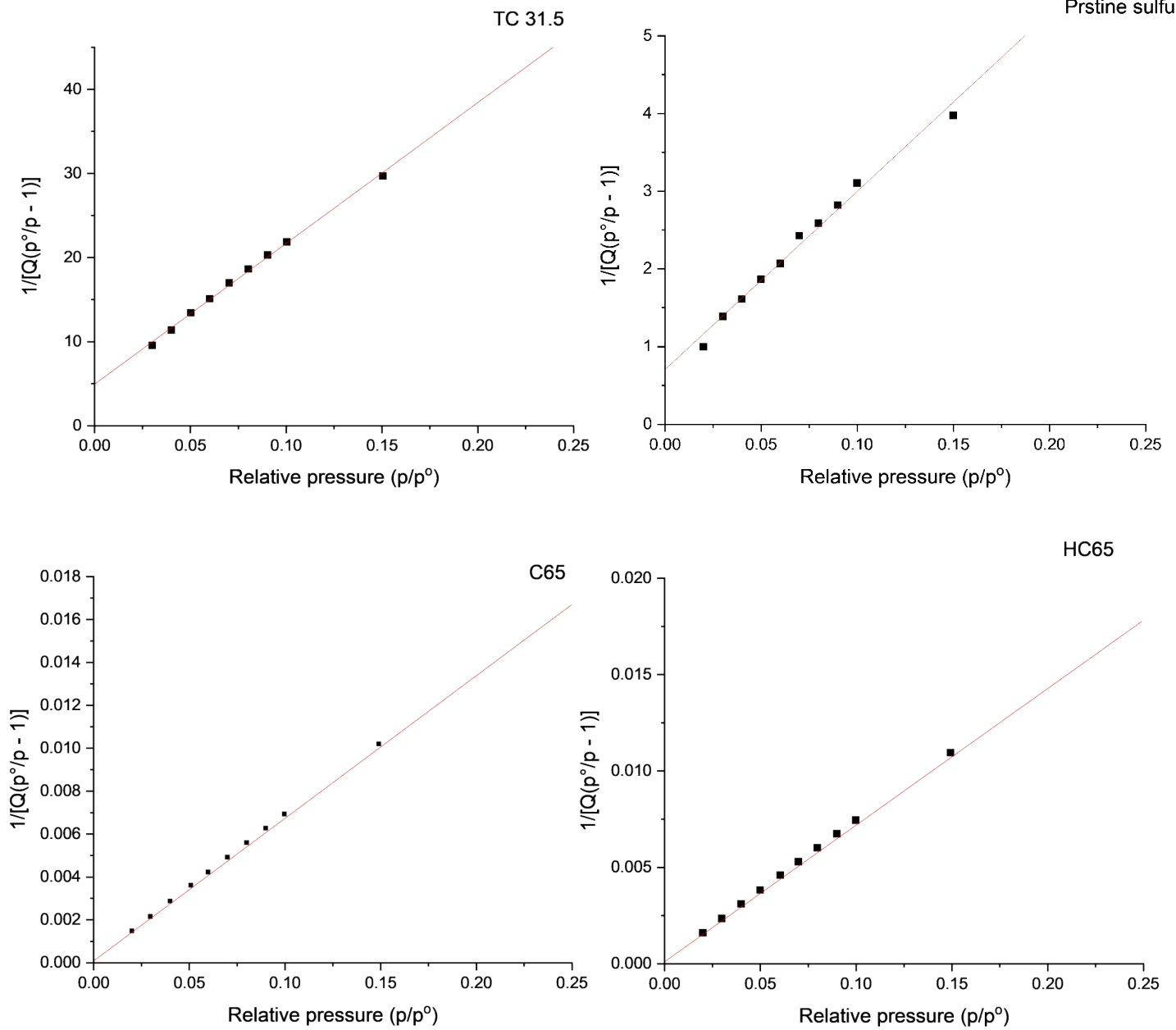


Figure S5: BET surface area plots for TC31.5, pristine sulfur, pristine C65 and HC65

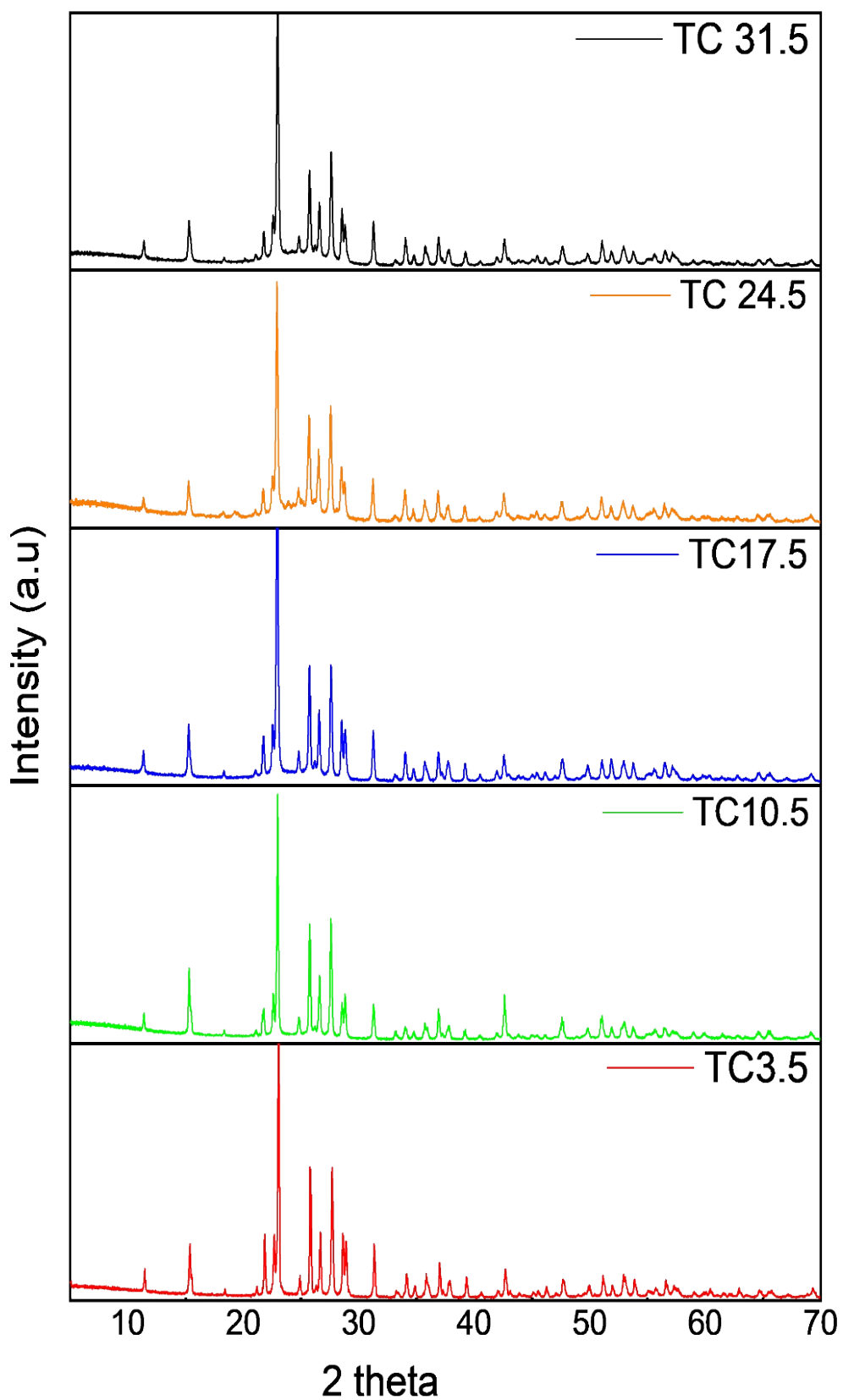


Figure S6: XRD pattern of TC cathode films



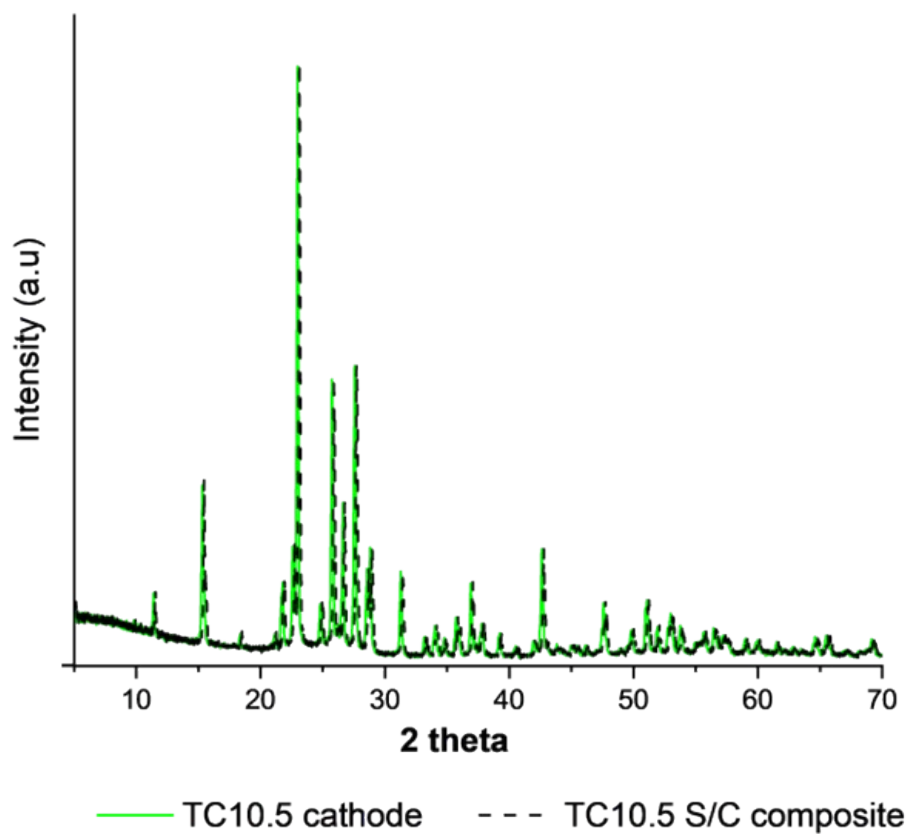


Figure S7: XRD pattern of TC10.5 cathode film with TC10.5 S/C composite

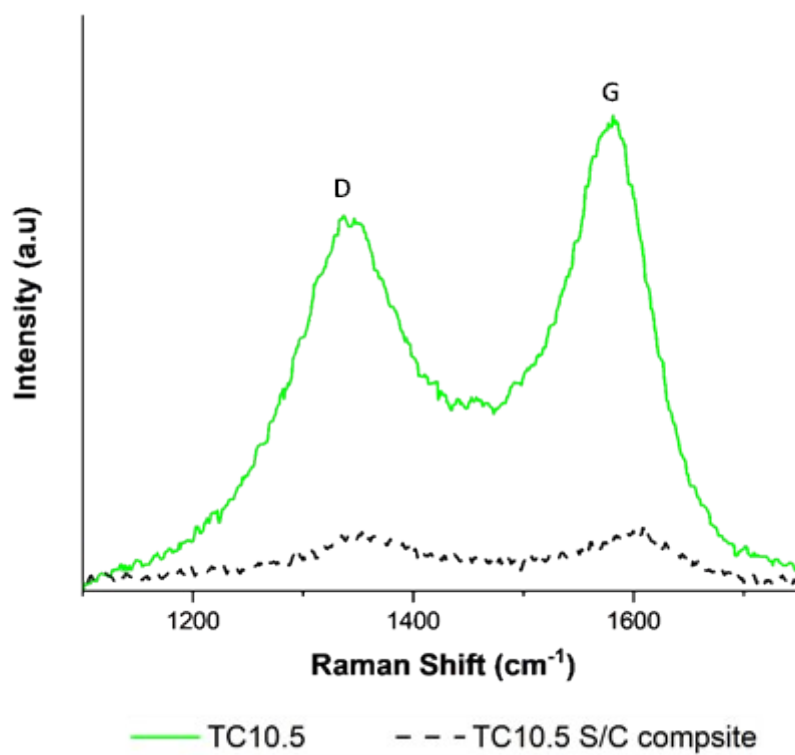


Figure S8: Raman D and G peaks pattern of TC10.5 cathode film with TC10.5 S/C composite

# XPS C1s and Sp2 Spectra

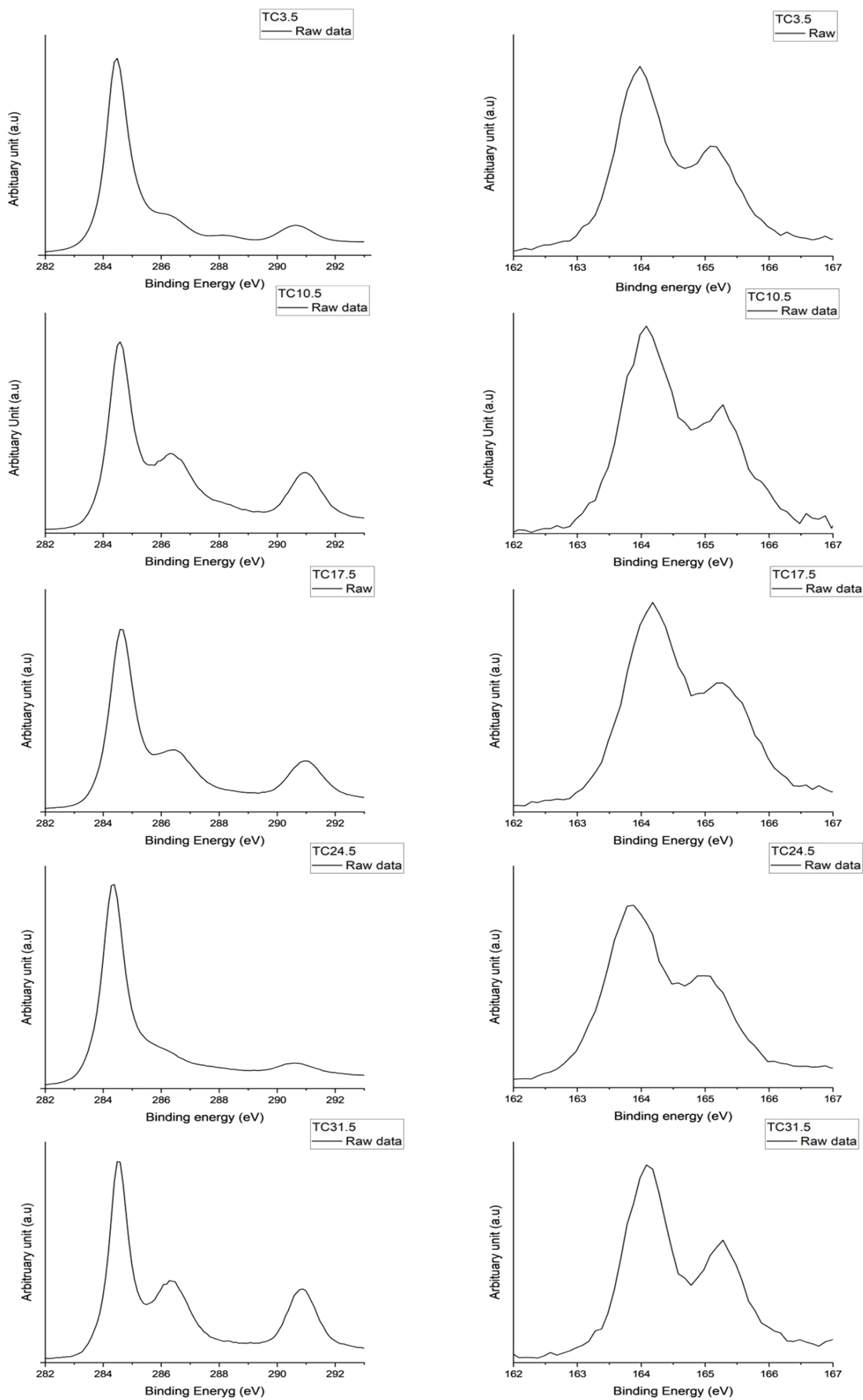


Figure S9a: C1s and S2p raw spectra for TC3.5, 10.5, 17.5, 24.5 and 31.5

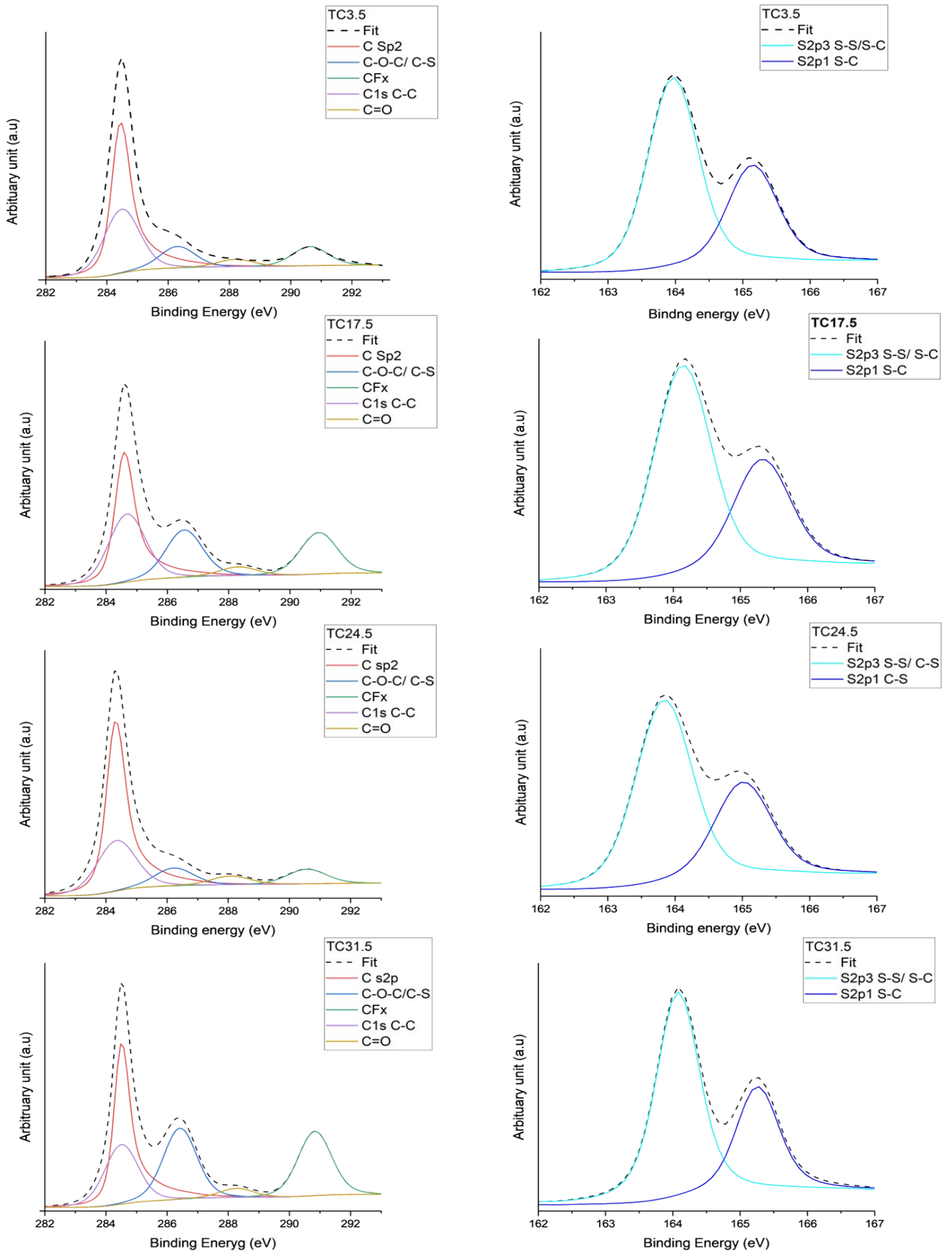


Figure S9b: C1s and S2p fitted spectra for TC3.5, 10.5, 17.5, 24.5 and 31.5

# XPS O1s spectrum

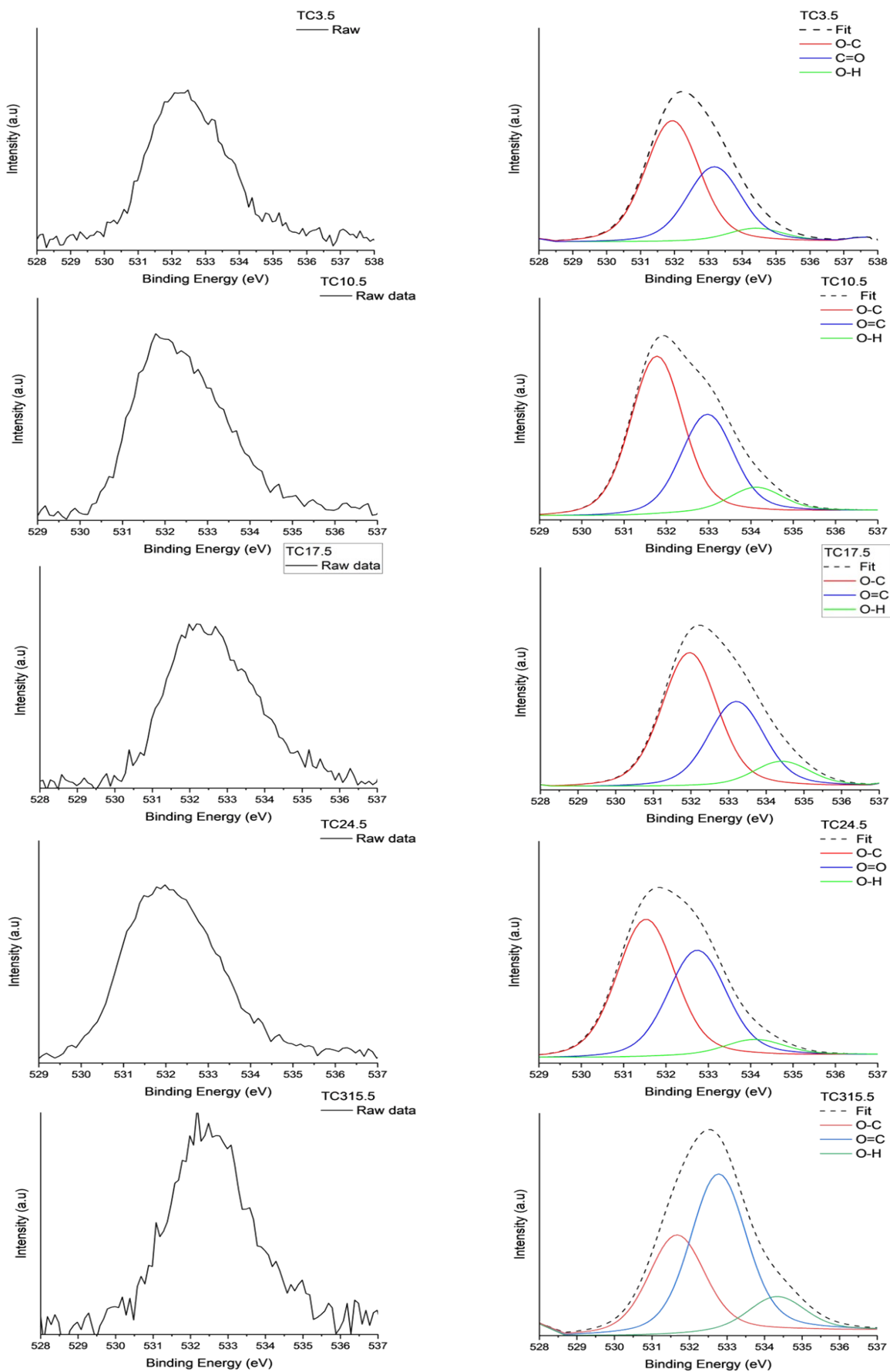


Figure S10: O1s raw and fitted spectra for all TC samples

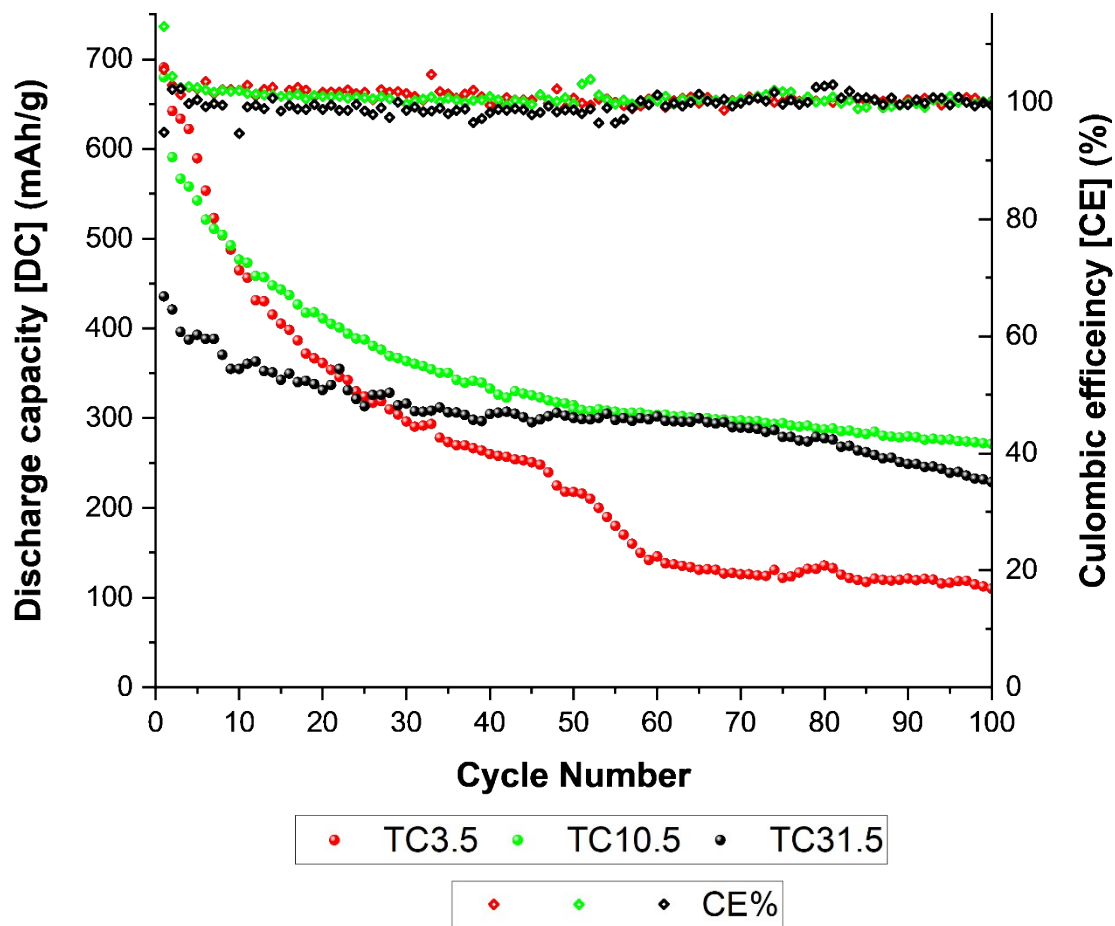


Figure S11: Discharge capacity and coulombic efficiency after 100 cycles

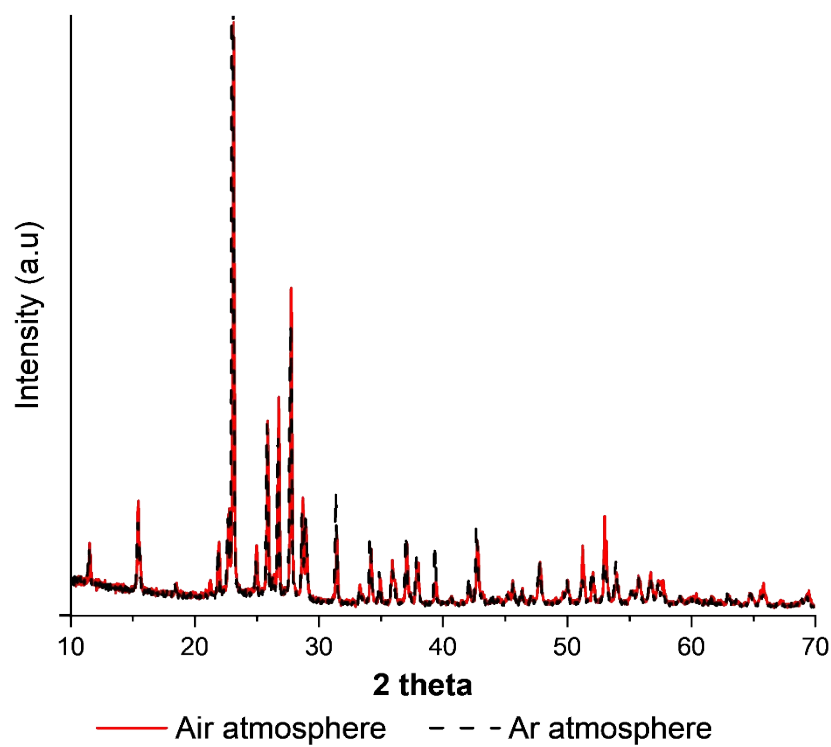


Figure S12: XRD pattern of TC composite milled in Ar and air atmosphere

**Table ST2:** Electronic conductivities of All TC cathode samples. C65 carbon black and heated C65 carbon black

<b>Sample</b>	<b><math>\sigma = (1/R_{\text{eff}})*(d/A)</math> (S/m)</b>
<b>TC3.5</b>	1.77E-03
<b>TC10.5</b>	2.15E-03
<b>TC17.5</b>	3.00E-03
<b>TC24.5</b>	3.08E-03
<b>TC31.5</b>	4.34E-03
<b>HC65</b>	5.10E-01
<b>Pristine C65</b>	1.08E-01