



香港城市大學
City University of Hong Kong

專業 創新 胸懷全球
Professional · Creative
For The World

CityU Scholars

Electrophoretic deposition of TiO₂-CNTs nanocomposite for cathode applications in Li-S batteries

Muhyodin, Ghulam; Shahzad, H. K.; Ghasghaie, S.; Liu, Han; Chung, C. Y.

Published: 01/05/2021

Document Version:

Final Published version, also known as Publisher's PDF, Publisher's Final version or Version of Record

License:

CC BY-NC

Publication record in CityU Scholars:

[Go to record](#)

Published version (DOI):

[10.1021/scimeetings.1c00063](https://doi.org/10.1021/scimeetings.1c00063)

Publication details:

Muhyodin, G., Shahzad, H. K., Ghasghaie, S., Liu, H., & Chung, C. Y. (2021). *Electrophoretic deposition of TiO₂-CNTs nanocomposite for cathode applications in Li-S batteries*. Paper presented at ACS Publications Symposium: The Power of Chemical Transformations, Hong Kong. <https://doi.org/10.1021/scimeetings.1c00063>

Citing this paper

Please note that where the full-text provided on CityU Scholars is the Post-print version (also known as Accepted Author Manuscript, Peer-reviewed or Author Final version), it may differ from the Final Published version. When citing, ensure that you check and use the publisher's definitive version for pagination and other details.

General rights

Copyright for the publications made accessible via the CityU Scholars portal is retained by the author(s) and/or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights. Users may not further distribute the material or use it for any profit-making activity or commercial gain.

Publisher permission

Permission for previously published items are in accordance with publisher's copyright policies sourced from the SHERPA RoMEO database. Links to full text versions (either Published or Post-print) are only available if corresponding publishers allow open access.

Take down policy

Contact lbscholars@cityu.edu.hk if you believe that this document breaches copyright and provide us with details. We will remove access to the work immediately and investigate your claim.

Electrophoretic deposition of TiO₂-CNTs nanocomposite for cathode applications in Li-S batteries

Ghulam Muhyodin, H. K. Shahzad, S. Ghasghaie, L. Han, C. Y. Chung

Department of Materials Science and Engineering, City University of Hong Kong, Hong Kong, China



香港城市大學
City University of Hong Kong

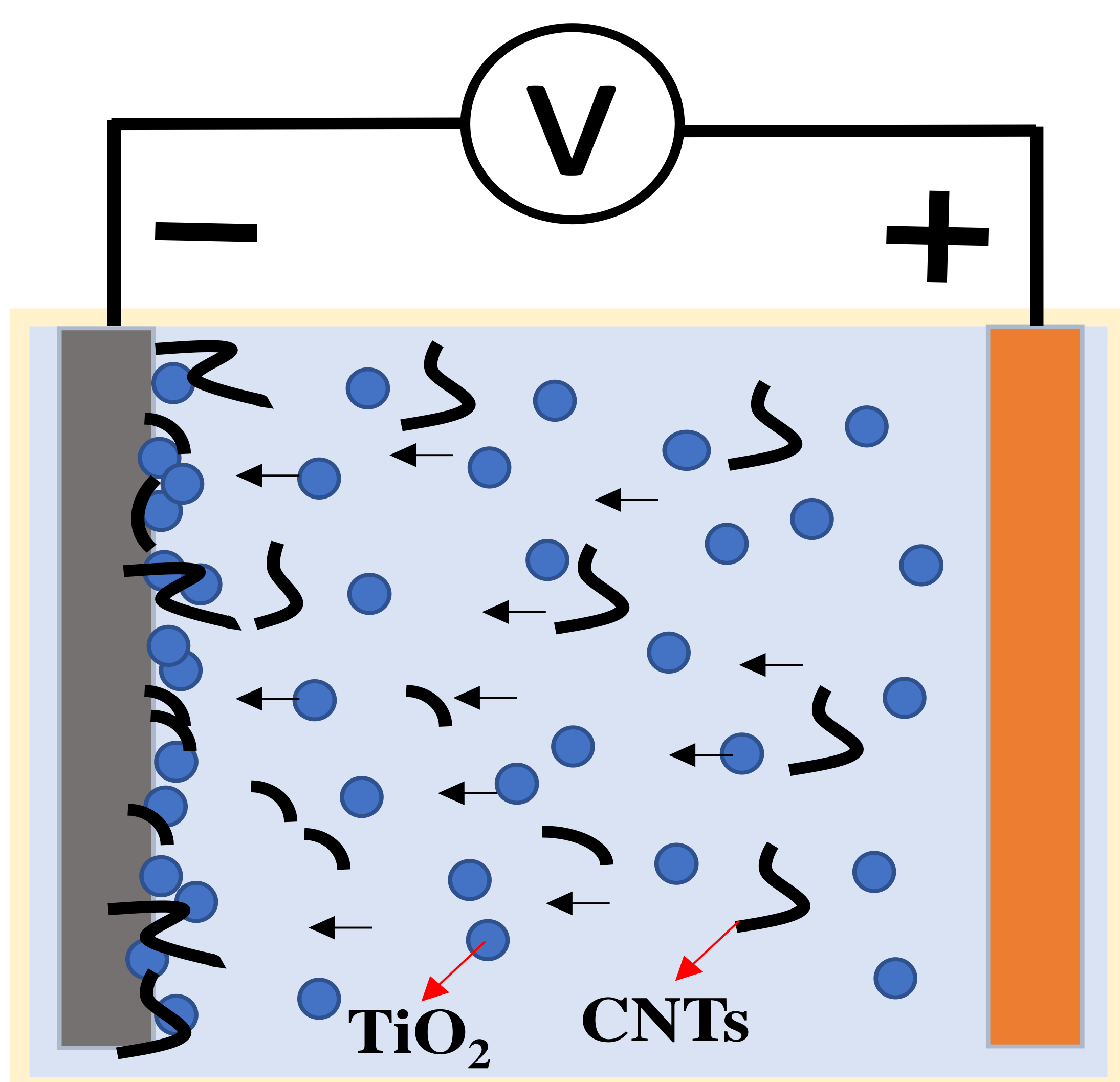
Overview

Over the last few decades, scientific research in the field of lithium-sulfur batteries (LSBs) has been surmounted because of their high theoretical capacity (1675 mAhg⁻¹) and energy density (2500 Whkg⁻¹). However, its practical application is behind the critical challenge associated with the irreversible dissolution of lithium polysulfide (LPSs) into the electrolyte which causes the shuttle effect. In the present study, titanium dioxide with carbon nanotubes (CNTs-TiO₂) nanocomposite was co-deposited on a carbon fiber paper to trap the long-chain polysulfide effectively. To fabricate the 3D cathode, a layer of CNTs-TiO₂ was deposited using a binder-free electrophoretic deposition (EPD) method. Elemental sulfur impregnation was carried out at 200 °C using the vapor-infusion technique. The prepared nano-composite presented outstanding electrochemical performance because of the synergistic effect of conductive CNTs and polar TiO₂. The CNTs-TiO₂/S nanocomposite cathode displayed the high initial discharge capacity of 1300 mAhg⁻¹ at 0.1C. The sample with 50% CNT showed higher capacity retention over prolonged cycling. The result indicated that the prepared cathode has a high potential for LSB cathode

Experimental

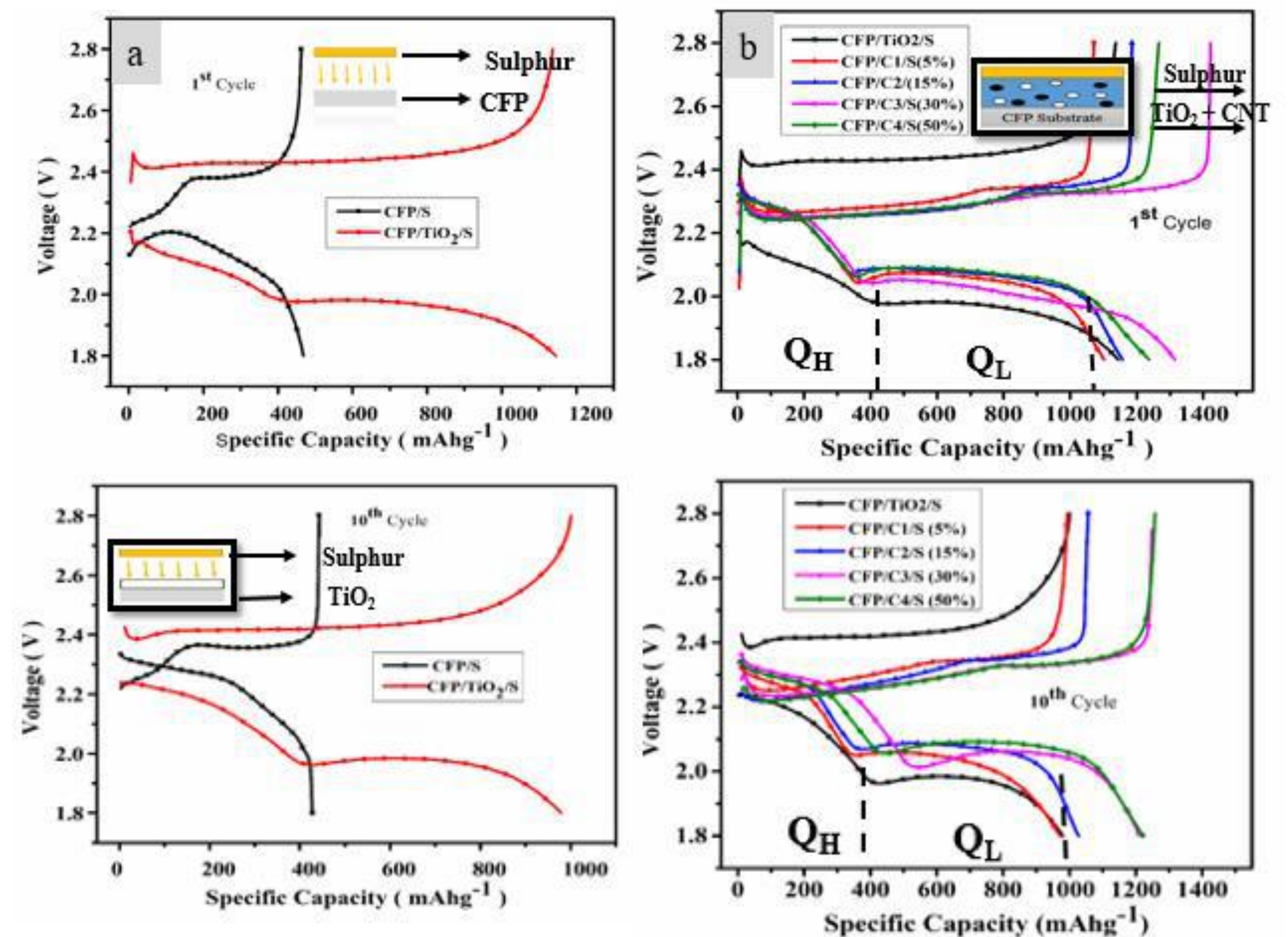
Table.1 Co-deposition of TiO₂-CNTs nanocomposite (TC) on carbon fiber paper substrate using EPD. TiO₂ is fixed (0.1g) .

Sr. No	CNT (Wt.) %	Comp. Areal loading (mgcm ²)	Sulfur (mg)	(C+S) wt. (mg)	E (μL)	C/S ratio	C/E ratio	S/A ratio (mgcm ⁻²)
C ₀	0	0	2.5	2.5	40	0	0	1.42
C ₁	0	10.62	2.5	8.5	40	2.4	0.15	1.42
C ₂	5	10.62	2.5	8.5	40	2.4	0.15	1.42
C ₃	15	10.62	2.5	8.5	40	2.4	0.15	1.42
C ₄	30	10.62	2.5	8.5	40	2.4	0.15	1.42
C ₅	50	10.62	2.5	8.5	40	2.4	0.15	1.42

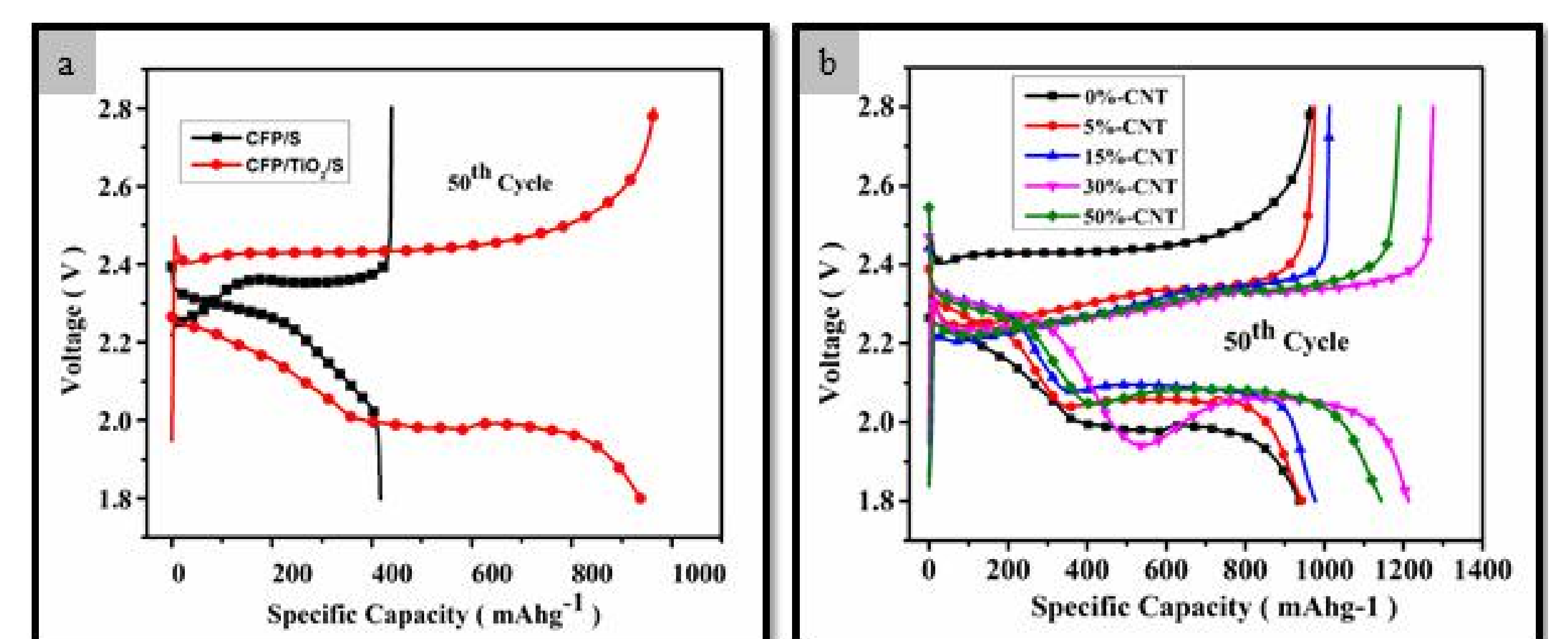


Graphical representation of LSBs mechanism upon discharge/charge with EPD deposition of (TiO₂-CNTs/S) composite on CFPs substrate

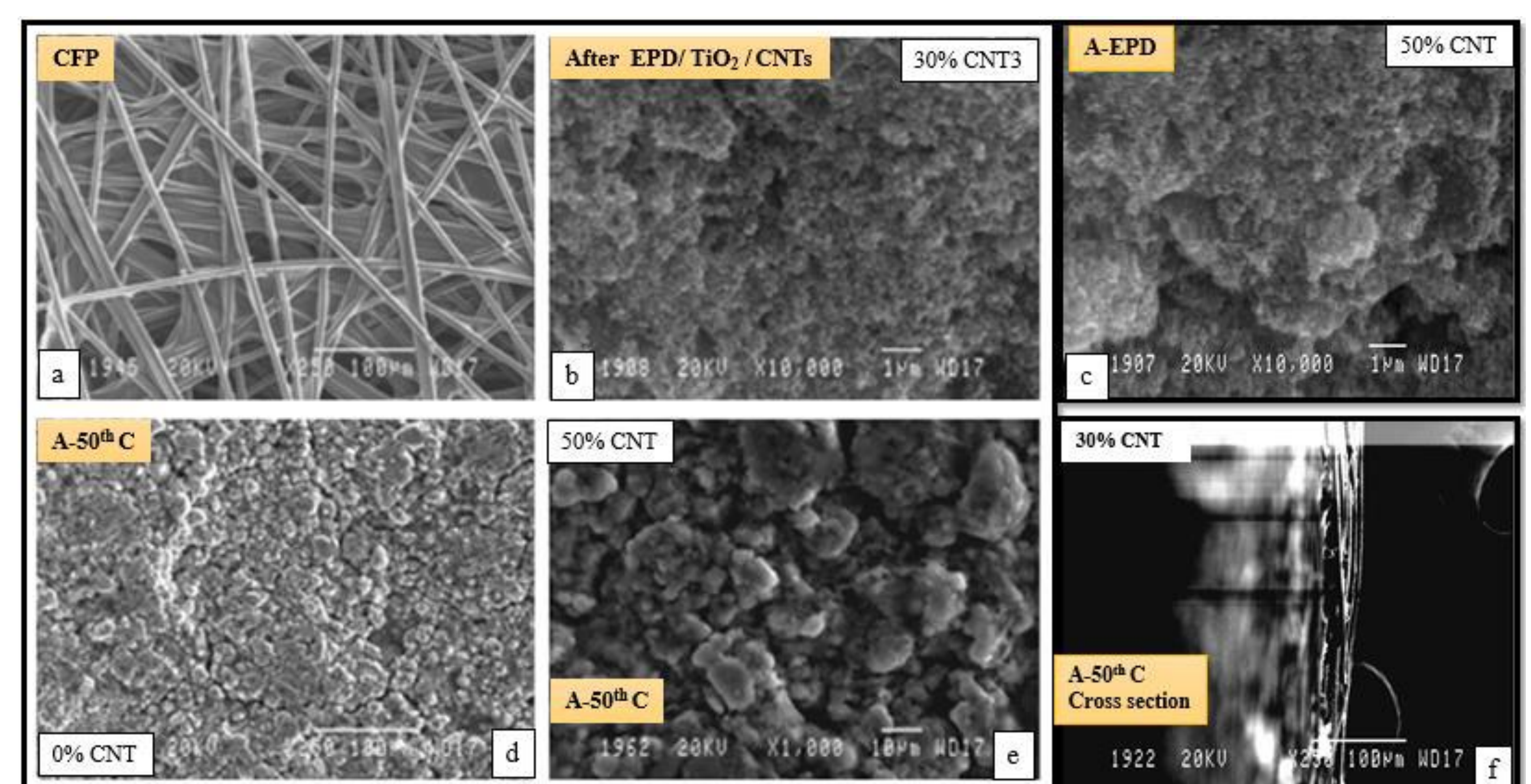
Results



a) cycling output of CFP/S and EPD-CFP/TiO₂/S, b) and EPD-CFP/TiO₂/CNTs/S with CNTs weight ratio (0-50) % for 1st and 10th Cycles.



The charge/discharge profile a) cycling output of CFP/S and EPD-CFP/TiO₂/S, b) and EPD-CFP/TiO₂/CNTs/S with CNTs weight ratio of (0-50) % for 50th Cycles.



SEM images (a-f) before and after EPD until the 50th cycling with cross sectional area of 30% CNTs

Conclusion

Electrophoretic deposition (EPD) technique was successfully employed to deposit various TiO₂-CNTs nanocomposite combinations (0-50%) CNTs on the 3D carbon based composite. The nanocomposite with 30% CNTs addition showed higher initial capacity 1340 mAhg⁻¹ and capacity retention 1250 mAhg⁻¹ after 50 cycles with no crack formation in the cathode. The result suggested that the prepared nanocomposite trapped the lithium polysulfides successfully because of the polar nature of TiO₂ while CNTs provided conductive pathways for smooth electron flow.