IOCN 2025 Conference
The 5th International Online Conference on Nanomaterials
22–24 September 2025 | Online
MDPI

The combined effect of brookite TiO_2 and magnetron-sputtered ITO film on the performance of dye-sensitized solar cells

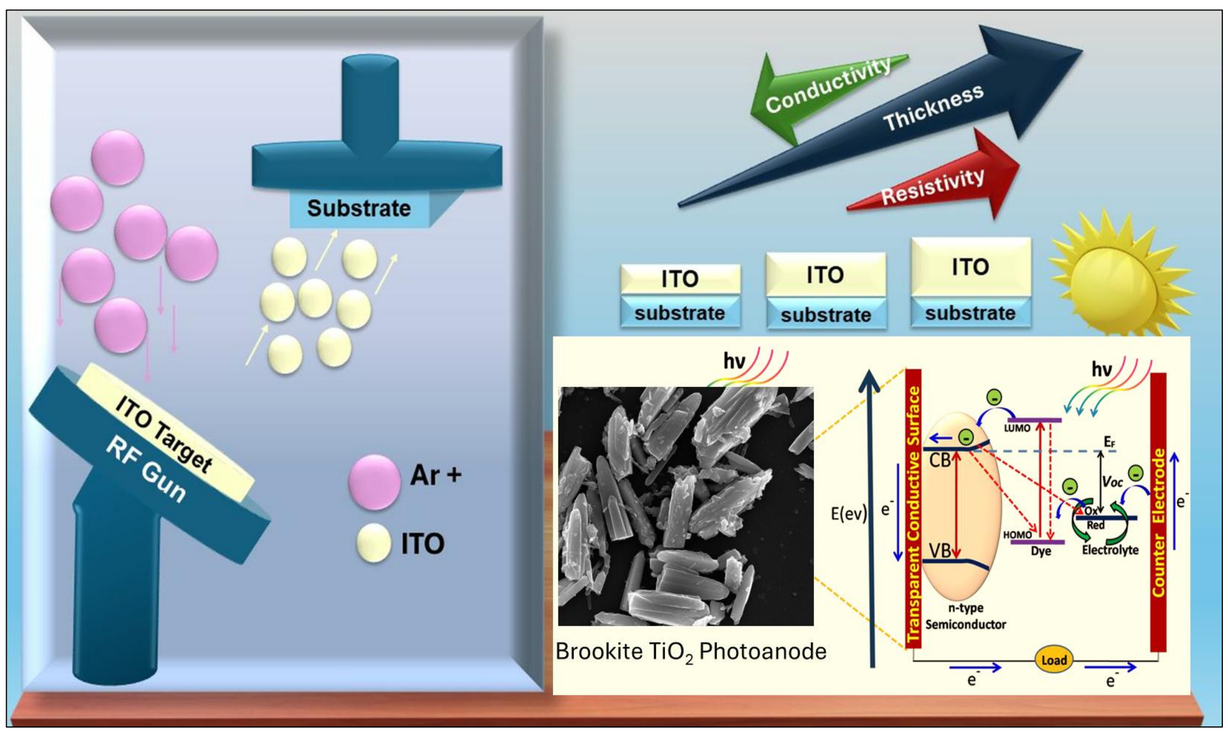
Shubhranshu Bhandari, Tapas Mallick
University of Exeter, Penryn Campus, TR10 9FE, Cornwall, United Kingdom

INTRODUCTION & AIM

The advancement of nanoscience and technology has brought new insight into the field of DSSCs (dye-sensitized solar cells). In this work, DSSCs were fabricated on top of an ITO (indium-doped tin oxide) film deposited by magnetron sputtering in the presence of monolithic inert gas. Further, the use of brookite TiO_2 (BTO) as a photoanode proved to have a significant influence on enhancing efficiency compared to the standard device.

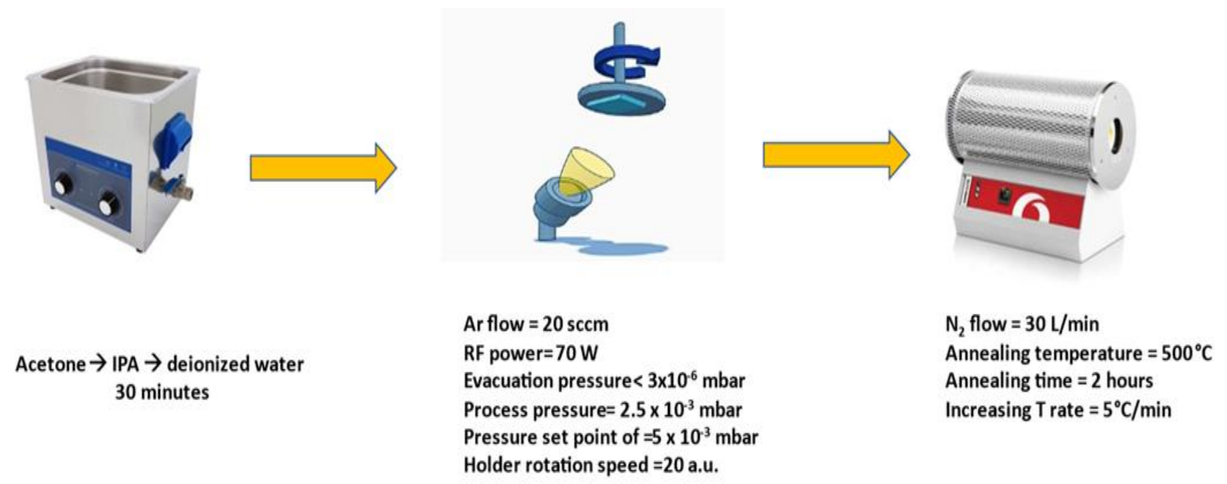
Aim: Enhanced charge transfer property of DSSC and significant improvement in photovoltaic performance by using high conductive ITO and rod shaped BTO.

Graphical Abstract



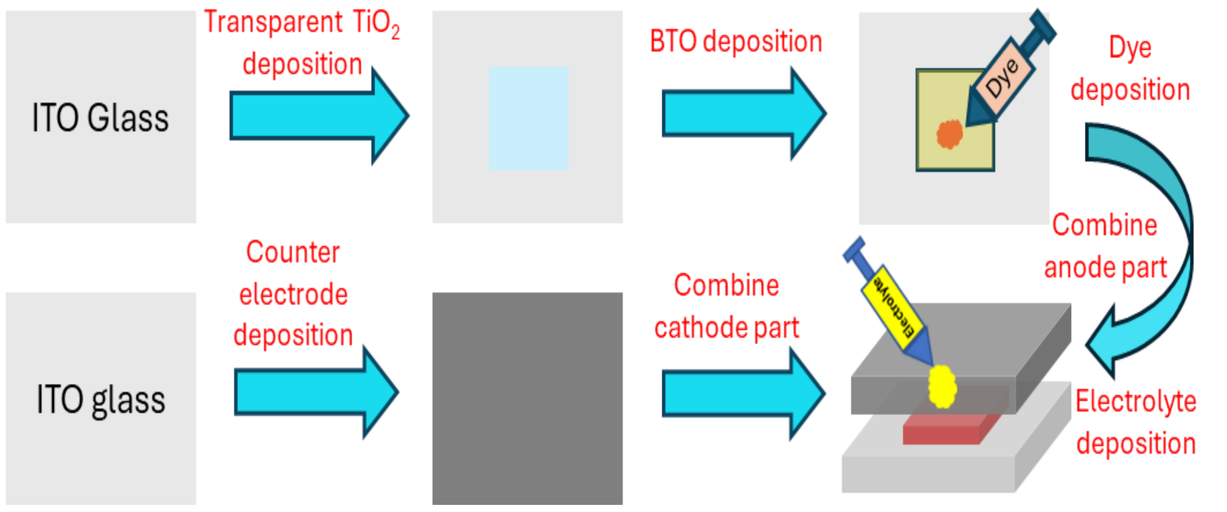
METHOD

Fabrication process of ITO thin films by magnetron sputtering



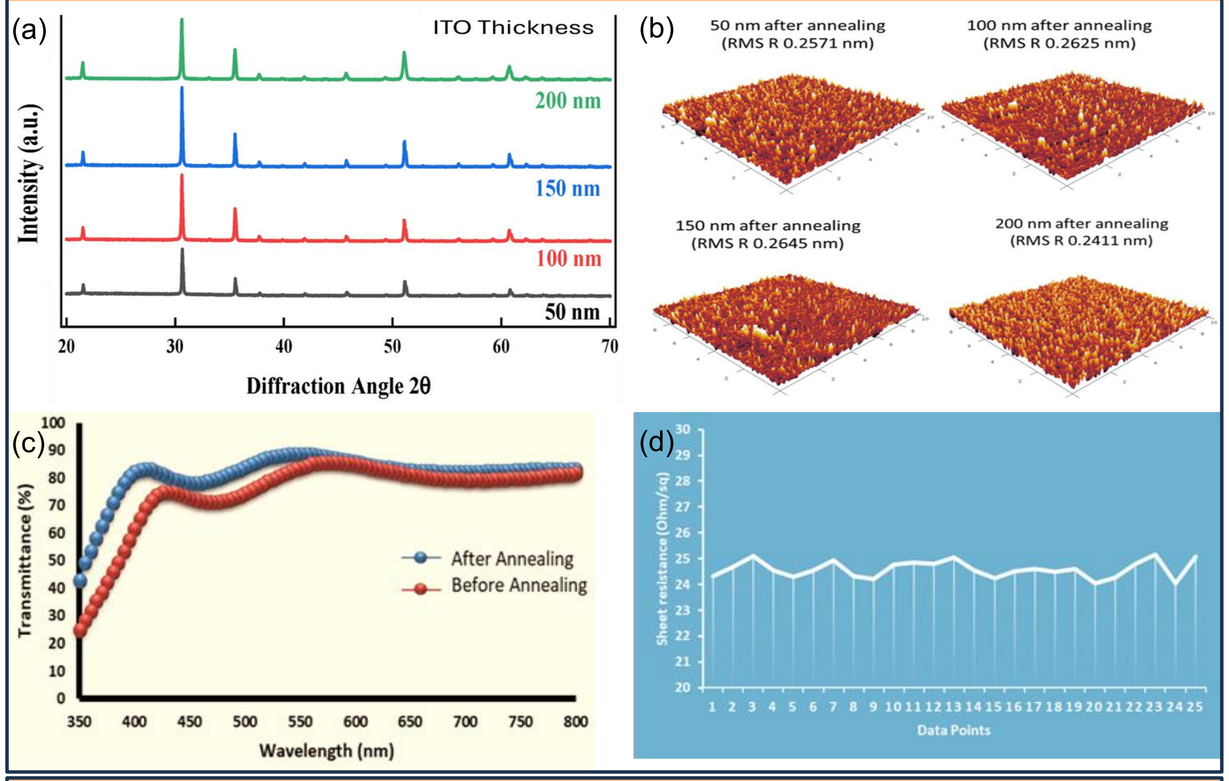
Synthesis of brookite TiO_2 (BTO) nano-rod

DSSC fabrication process

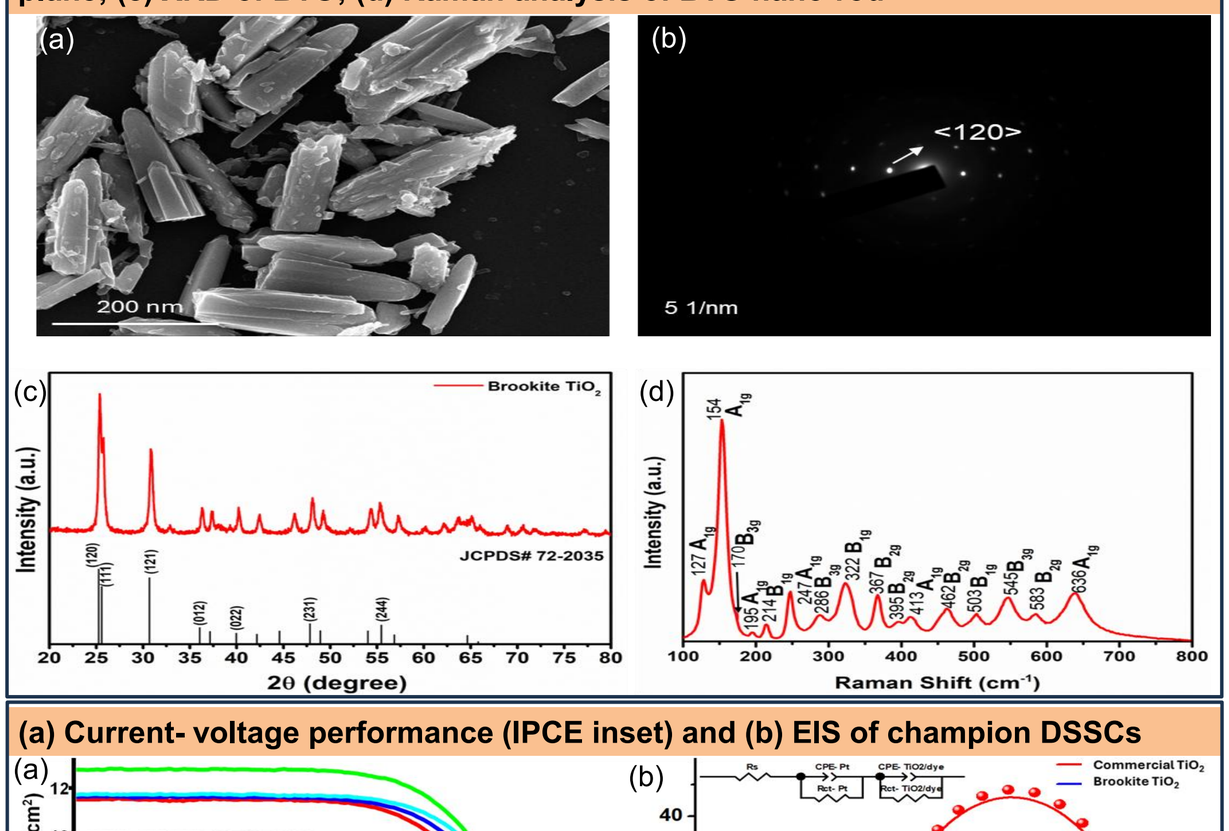


RESULTS & DISCUSSION

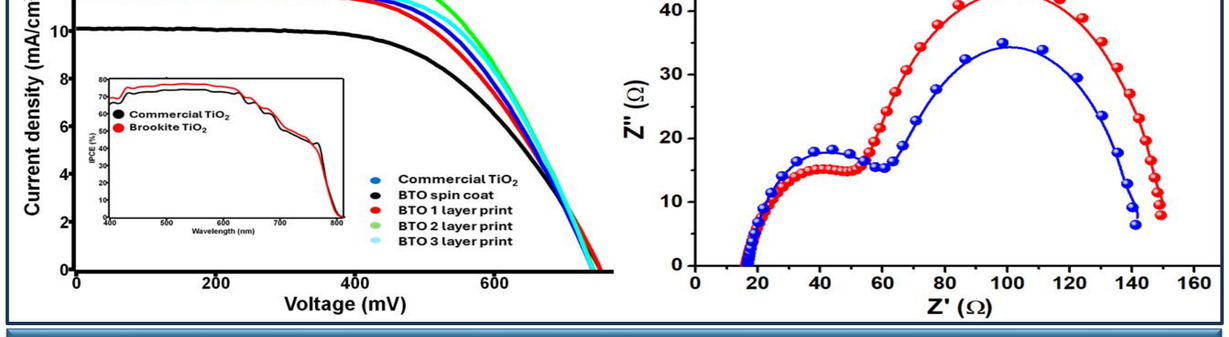
(a) XRD pattern of ITO samples; (b) AFM images of ITO films; (c) UV-visible transmittance of ITO (150 nm); (d) sheet resistance behaviour of ITO film (150 nm)



(a) SEM image of BTO nanostructures; (b) SAED pattern of BTO indicating major plane; (c) XRD of BTO; (d) Raman analysis of BTO nano-rod



(a) Current- voltage performance (IPCE inset) and (b) EIS of champion DSSCs



CONCLUSION

The introduction of laboratory-developed ITO and combination with synthesized brookite TiO_2 shows a new approach to enhancing the efficiency **(PCE ~7.7%, which is 28% higher compared to a commercial TiO_2)** of DSSCs. The importance of quality thin-film deposition by RF magnetron and the importance of the variable crystal structure of TiO_2 or other semiconducting materials for photovoltaic devices are demonstrated.

FUTURE WORK / REFERENCES

Future work: Magnetron sputtered transparent conductive oxide and charge transport layer fabrication for perovskite solar cell with enhanced efficiency and stability.

Reference: 1. *Bhandari, S.; Roy, A.; Mallick, T. K.; Sundaram, S.* ***Chemical Engineering Journal****, 2022, 446 (5), 137378.*
2. Alabdan, H. I.; Alsahli, F. M.; Bhandari, S.; Mallick, T. K. ***Nanomaterials****, 2024, 14(7), 565.*