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High-Performance Bi-Layer TiO_2 Structures in DSSCs

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INTRODUCTION & AIM

The rutile TiO_2 nanorods (NRs) and nanoflowers (NFs) nanostructure (NS) offer direct conductive pathways and reducing electron-hole recombination. However, the compact TiO_2 structure limits dye absorption, which leads to poor Dye Sensitized Solar Cell (DSSCs) performance. To address this issue, an **etching treatment** is proposed to modify the surface structure. This treatment increased the surface area and decreased electrical resistivity, resulting in improved bi-layer TiO_2 properties. As the result, the power energy conversion (PEC) efficiency increased to 10.05%, compared to 6.41% for the non-etched.

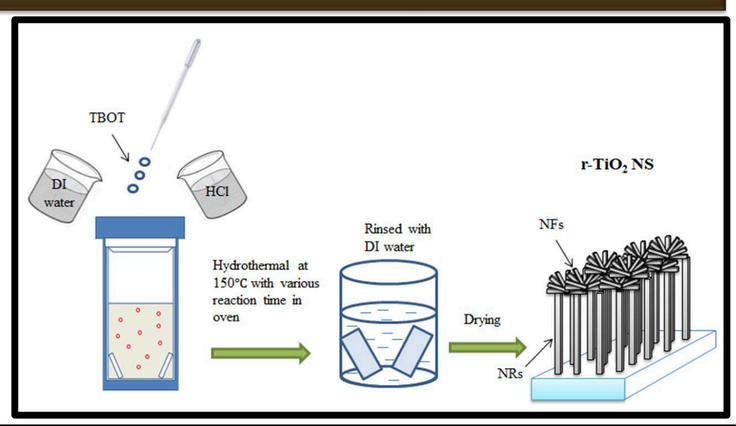
Potential Application

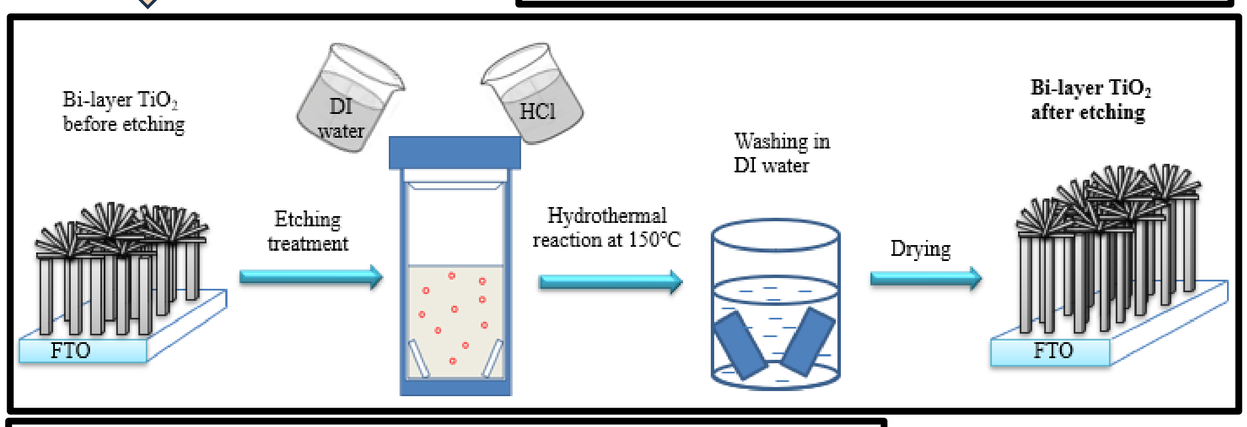
- Wastewater treatment. - Air pollutant. - Anti-corrosive.
- Hydrogen fuel cell. - Heterojunction solar cell.
- Self-cleaning agent, etc.

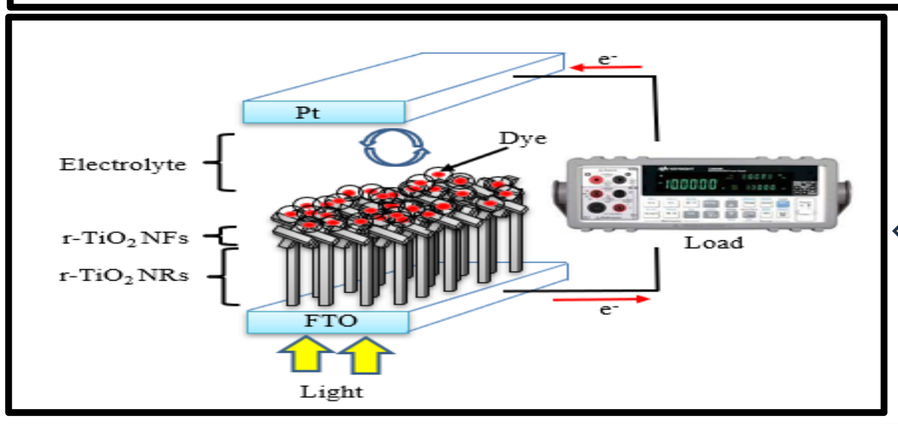
METHOD

1. Synthesis bi-layer rutile TiO_2 on FTO substrate

2. Etching treatment of bi-layer rutile TiO_2







3. Solar simulation for DSSC PEC Efficiency measurement

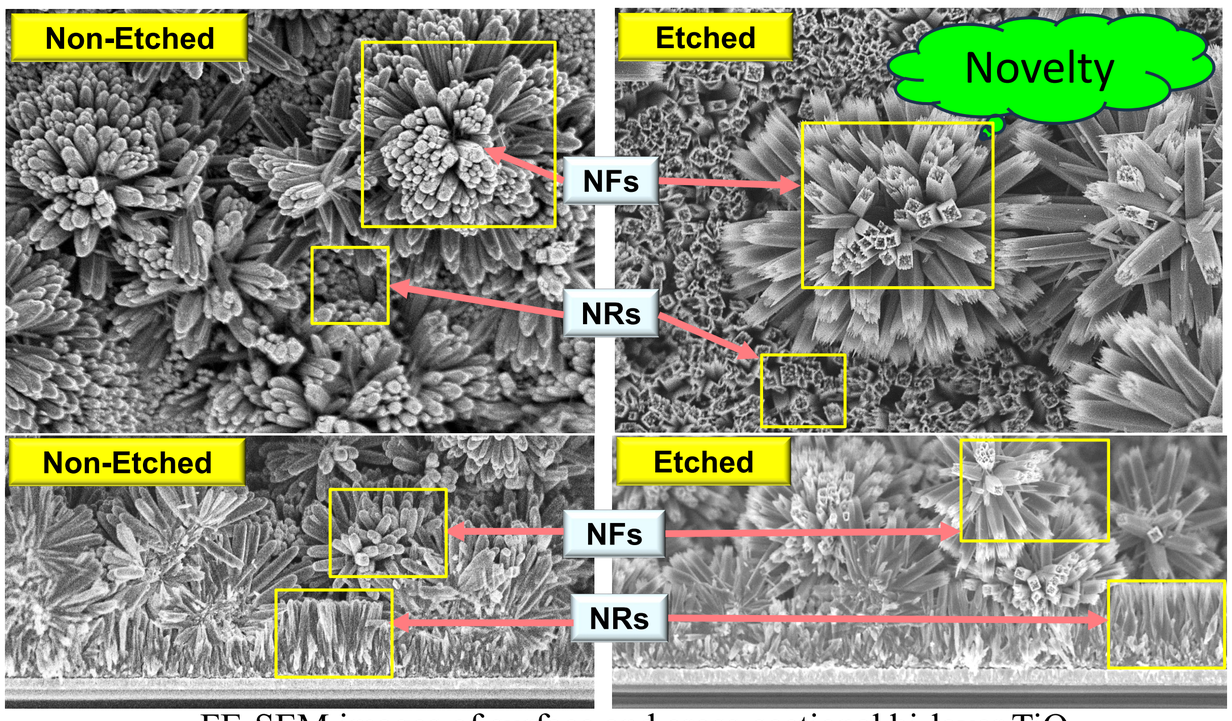
Characterization Technique

- PANanalytical X-Pert3 Powder X-ray diffraction (XRD).
- FE-SEM, JOEL, JSM-7600F.
- 4Point Probe (Signatone Pro4-440N)
- Kethley 2420 source meter, Newport Oriel solar simulator (AM1.5G irradiation)

RESULTS & DISCUSSION

Sample	β	D (nm)	Phase & Plane
Non-etched	0.1181	94.6	Rutile (101)
Etched	0.1574	65.4	Rutile (101)

Notes: β = FWHM, D = crystallite size



FE-SEM images of surface and cross-sectional bi-layer TiO_2

Sample	ρ (Ω.cm)
Non-etched	0.34
Etched	**0.19**

Electrical Properties

Cell Performance

Sample	V_{oc} (V)	Jsc (mA/cm²)	FF (%)	Efficiency, η (%)
Non-etched	0.7060	11.6475	77.98	6.41
Etched	0.7561	27.7249	47.96	**10.05**

SDG Impact

CONCLUSION

The etched bi-layer TiO_2 was successfully fabricated and demonstrated its effectiveness in tuning the structure. The increase in Jsc is manifestly associated with the hollow structure, which facilitated dye molecules adsorption.

FUTURE WORK / REFERENCES

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