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# Supporting Information

# A Novel porous Ti/TiN/Ti thin film as working electrode for back-contact, monolithic and non-TCO dye-sensitized solar cells

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Table S1. Summary of sheet resistivity and film thickness for sputtered TiN thin film under various nitrogen flows and Ti-TiN-Ti thin film.

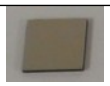
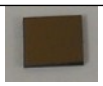
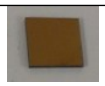
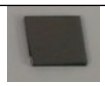
| |  |  |  |  | Ti-TiN-Ti thin film |
|---|---|---|---|---|---|
| $N_2$ / (Ar +$N_2$) flow ratio | 0.6/(0.6+30) | 1.0/(1.0+30) | 1.5/(1.5+30) | 2.5/(2.5+30) | |
| Sheet resistivity (Ω/□) | 2.38 | 4.10 | 5.27 | 13.30 | 7.74 |
| Film thickness (nm) | 560 | 500 | 450 | 330 | 450 |

Table S2. Complete photovoltaic performances of BC-DSCs and Ref-DSCs using photoanodes with various thickness of $TiO_2$ layer sensitized with Z-907 dye and MK-2 dye, respectively.

| | $TiO_2$ Thickness (μm) | $V_{OC}$ (mV) | $J_{SC}$ (mA/cm$^2$) | FF | PCE (%) |
|---|---|---|---|---|---|
| BC-DSCs Z-907 | 2.3 | 780 | 3.13 | 0.71 | 1.73 |
| | 4.0 | 740 | 6.88 | 0.71 | 3.69 |
| | 8.8 | 720 | 8.25 | 0.70 | 4.17 |
| | 10.6 | 720 | 9.06 | 0.69 | 4.53 |
| | 14.8 | 700 | 8.07 | 0.68 | 3.90 |
| BC-DSCs MK-2 | 2.3 | 760 | 6.50 | 0.72 | 3.55 |
| | 4.0 | 740 | 7.53 | 0.71 | 3.95 |
| | 8.8 | 740 | 7.88 | 0.71 | 4.16 |
| | 10.6 | 720 | 7.38 | 0.69 | 3.68 |
| | 14.8 | 720 | 6.74 | 0.68 | 3.29 |
| | $TiO_2$ Thickness (μm) | $V_{OC}$ (mV) | $J_{SC}$ (mA/cm$^2$) | FF | PCE (%) |
| Ref-DSCs Z-907 | 2.3 | 780 | 6.53 | 0.77 | 3.94 |
| | 4.0 | 760 | 8.58 | 0.74 | 4.8 |
| | 8.8 | 760 | 10.63 | 0.72 | 5.80 |
| | 10.6 | 740 | 11.25 | 0.72 | 6.0 |
| | 14.8 | 740 | 9.75 | 0.71 | 5.17 |
| Ref-DSCs MK-2 | 2.3 | 780 | 7.44 | 0.71 | 4.11 |
| | 4.0 | 760 | 8.31 | 0.71 | 4.51 |
| | 8.8 | 760 | 10 | 0.70 | 5.36 |
| | 10.6 | 740 | 9.75 | 0.68 | 4.87 |
| | 14.8 | 720 | 8.81 | 0.66 | 4.17 |

Table S3. Photovoltaic parameters of BC-DSCs using 350 nm Ti-TiN-Ti electrode with Z-907 dye and MK-2 dye.

| | $TiO_2$ Thickness (μm) | $V_{OC}$ (mV) | $J_{SC}$ (mA/cm$^2$) | FF | PCE (%) |
|---|---|---|---|---|---|
| BC-DSCs Z-907 | 11.3 | 740 | 5.39 | 0.64 | 2.58 |
| BC-DSCs MK-2 | 9.0 | 783 | 5.71 | 0.68 | 3.04 |

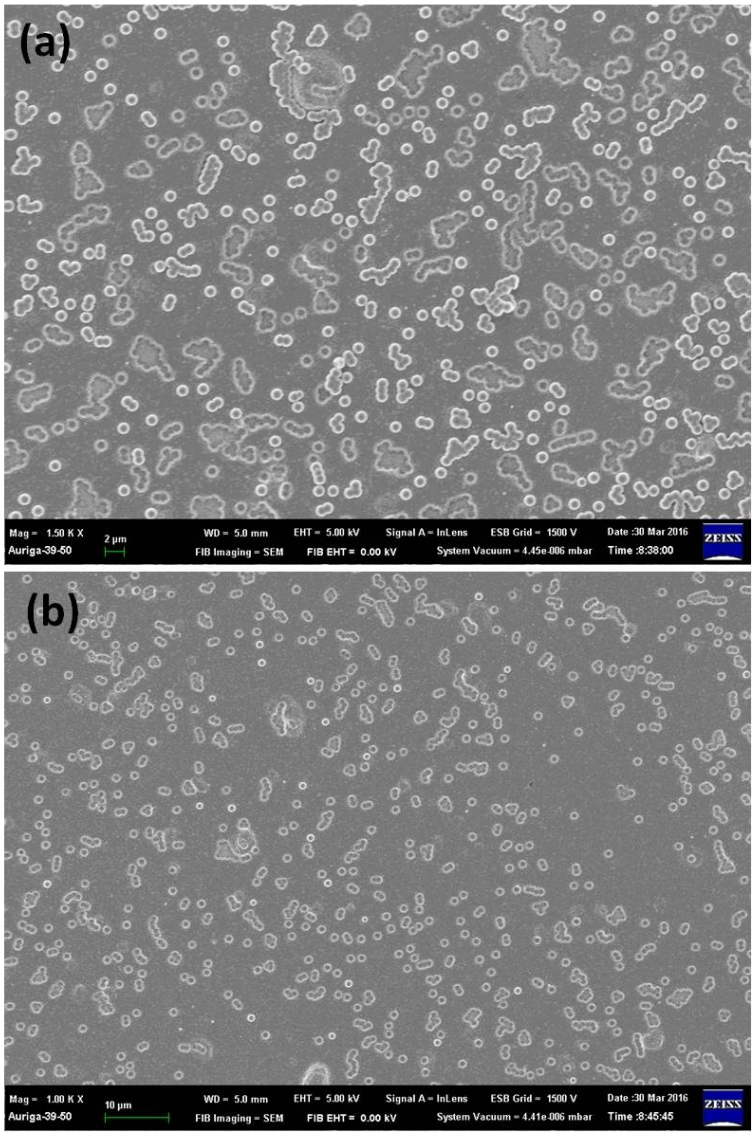



Figure S1. The SEM image for (a) incomplete and (b) complete removal of polystyrene balls

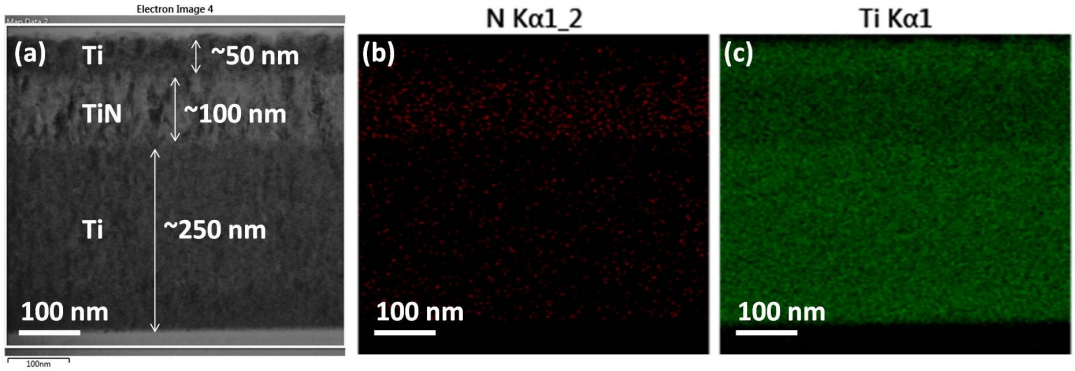



Figure S2. (a) Cross-sectional TEM image of Ti-TiN-Ti tri-layer deposited on glass substrate. Energy dispersive X-ray spectroscopy (EDX) mapping of relevant elements of (b) N, and (c) Ti for Ti-TiN-Ti tri-layer.

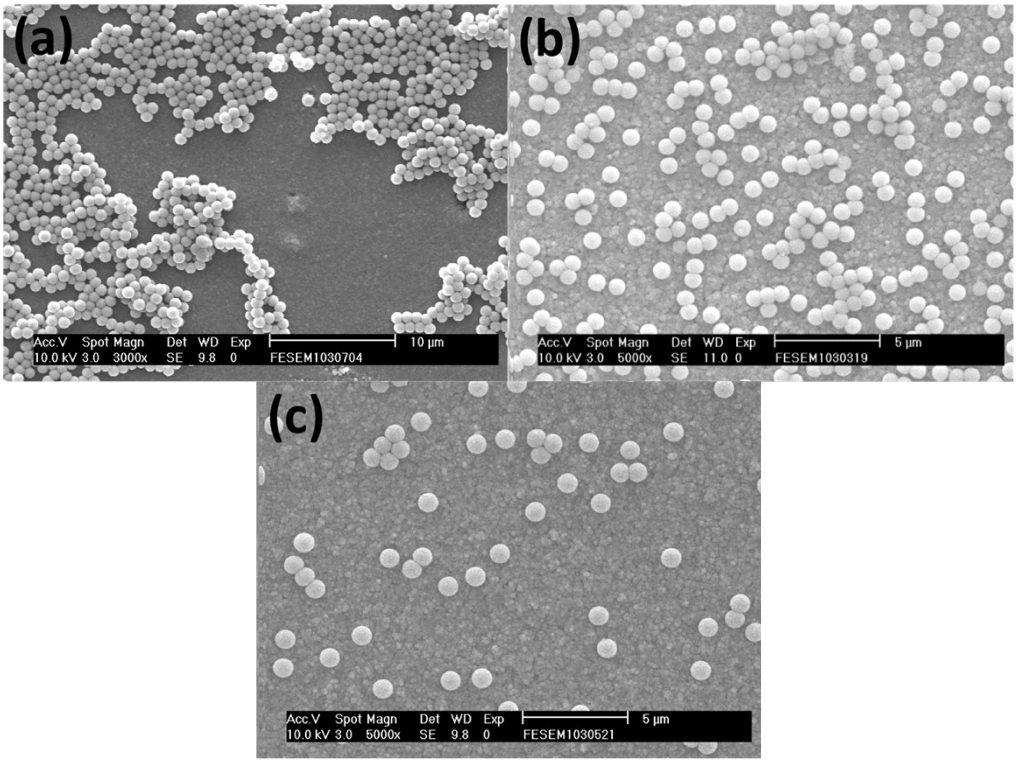



Figure S3. SEM images of polystyrene distributed on meso-$TiO_2$ layer after deposition of Ti-TiN-Ti thin films resulting from solution of (a) polystyrene:ethanol (1:50), (b)polystyrene:ethanol (1:99), and (c) polystyrene:ethanol (1:199).

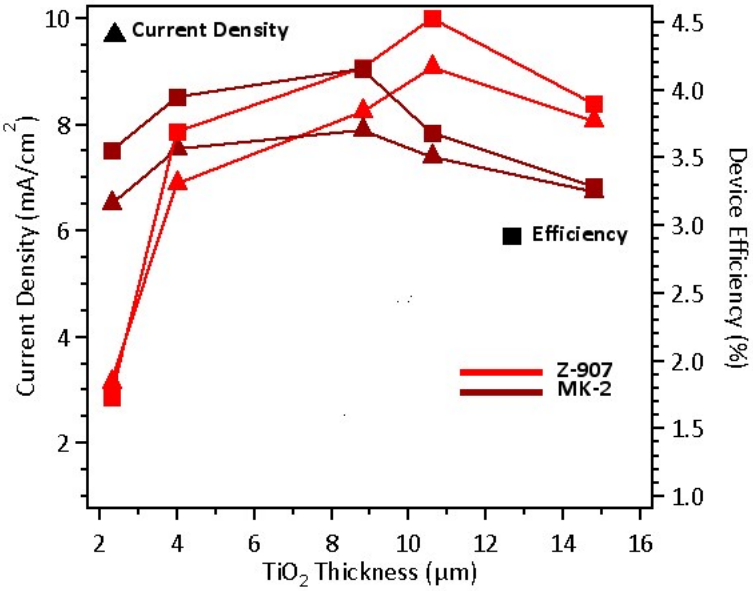



Figure S4. The dependence of $TiO_2$ layer thickness versus short-circuit current density and device efficiency for BC-DSCs sensitized with Z-907 dye and MK-2 dye.