**Table R1.** Summary of $TiO_2$ based DSSCs with their corresponding components in recent two years

| photoanode | dye | electrolyte | counter electrode | Efficiency (%) | Reports |
|---|---|---|---|---|---|
| **NP-MS** | **N719** | **$I^-/I_3^-$** | **Pt** | **7.32** | **Current work** |
| TNT | N719 | $I^-/I_3^-$ | Pt | 3.62 | [47] |
| 3DOM/m | N719 | $I^-/I_3^-$ | Pt | 9.20 | [48] |
| P25 | N719<br>BD | $I^-/I_3^-$ | Pt | 3.85 | [49] |
| HNP/SP | N719 | $I^-/I_3^-$ | Pt | 8.65 | [50] |
| TCS/3DMS | N719 | $I^-/I_3^-$ | Pt | 6.83 | [33] |
| RGO-3DGNs-$TiO_2$ | N719 | $I^-/I_3^-$ | Pt | 7.68 | [51] |
| NP/MS | N719 | LOMG | Pt | 7.66 | [52] |
| B-TNA | N719 | $I^-/I_3^-$ | Pt | 8.02 | [53] |

$$Z = \left(\frac{R_t R_r}{1 + i\omega/\omega_k}\right)^{\frac{1}{2}} \coth\left[\left(\frac{\omega_k}{\omega_d}\right)^{\frac{1}{2}}\left(1 + \frac{i\omega}{\omega_k}\right)\right]^{\frac{1}{2}} \qquad \text{Eq S1}$$

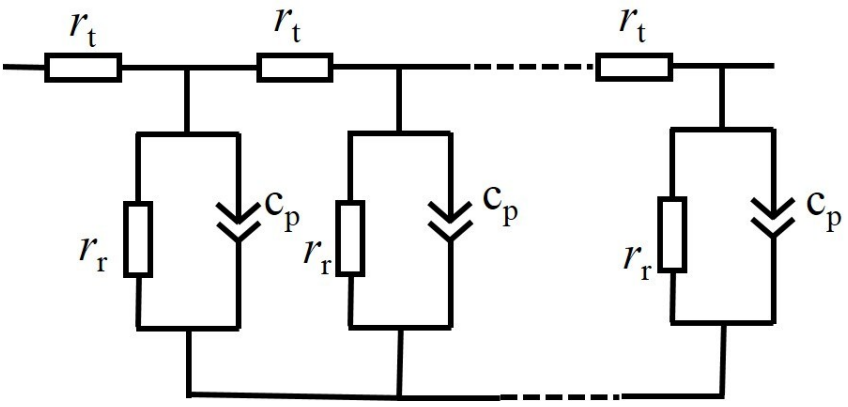


**Figure S1.** The composition of DX1.