# Electronic Supporting Information

# Improved Electron Transfer and Plasmonic Effect in Dye-sensitized Solar Cells with Bi-functional Nb-doped $TiO_2$/Ag Ternary Nanostructures

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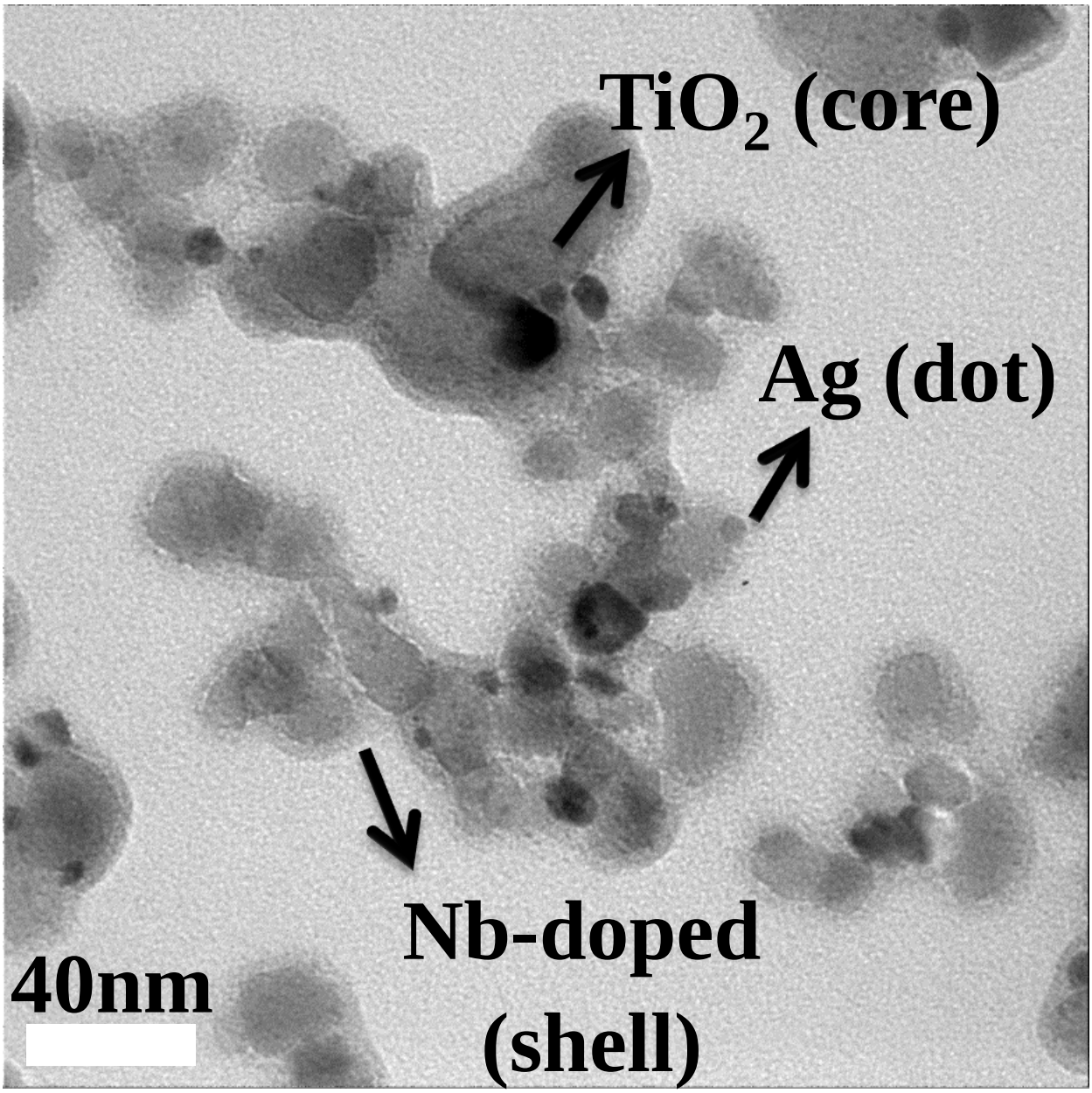


Fig. S1. Magnified EF-TEM micrograph of the bi-fuctional Nb-doped $TiO_2$/Ag ternary nanostructure.

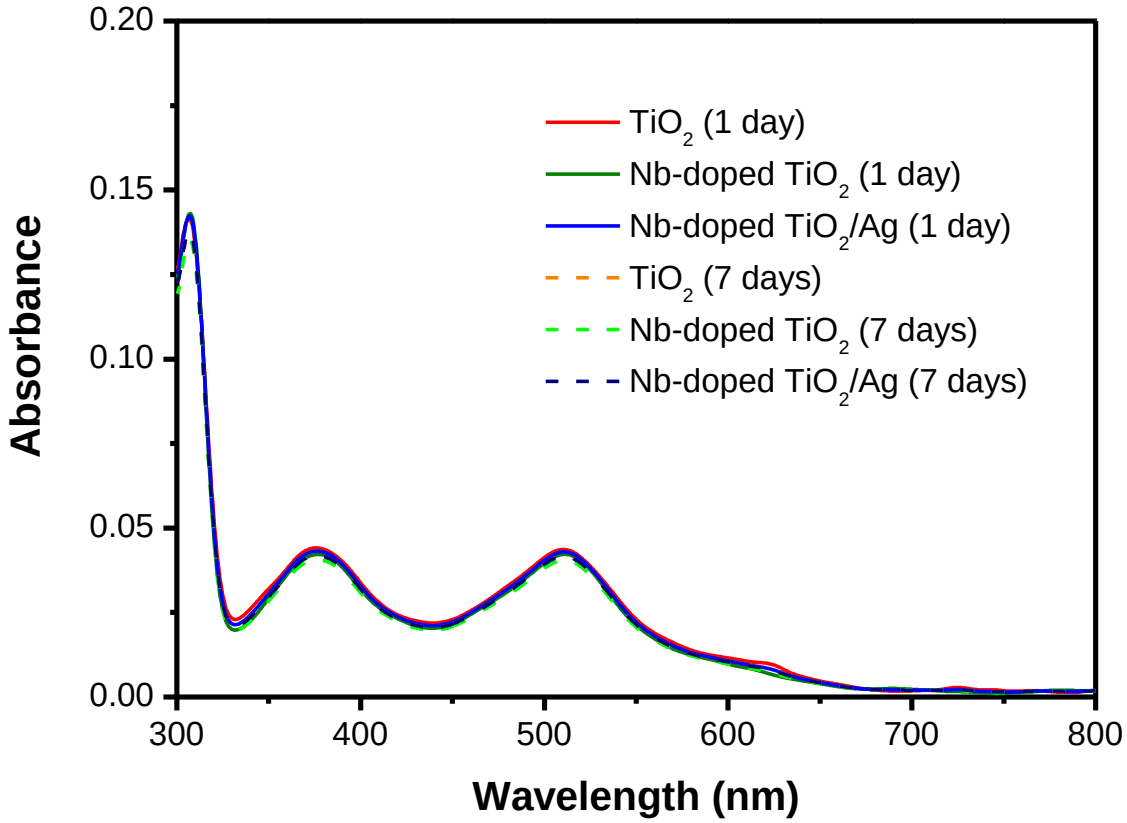


Fig. S2. UV-visible spectra of N719 dye loading on $TiO_2$, Nb-doped $TiO_2$ and Nb-doped $TiO_2$/Ag ternary nanostructure after 1 and 7 days.

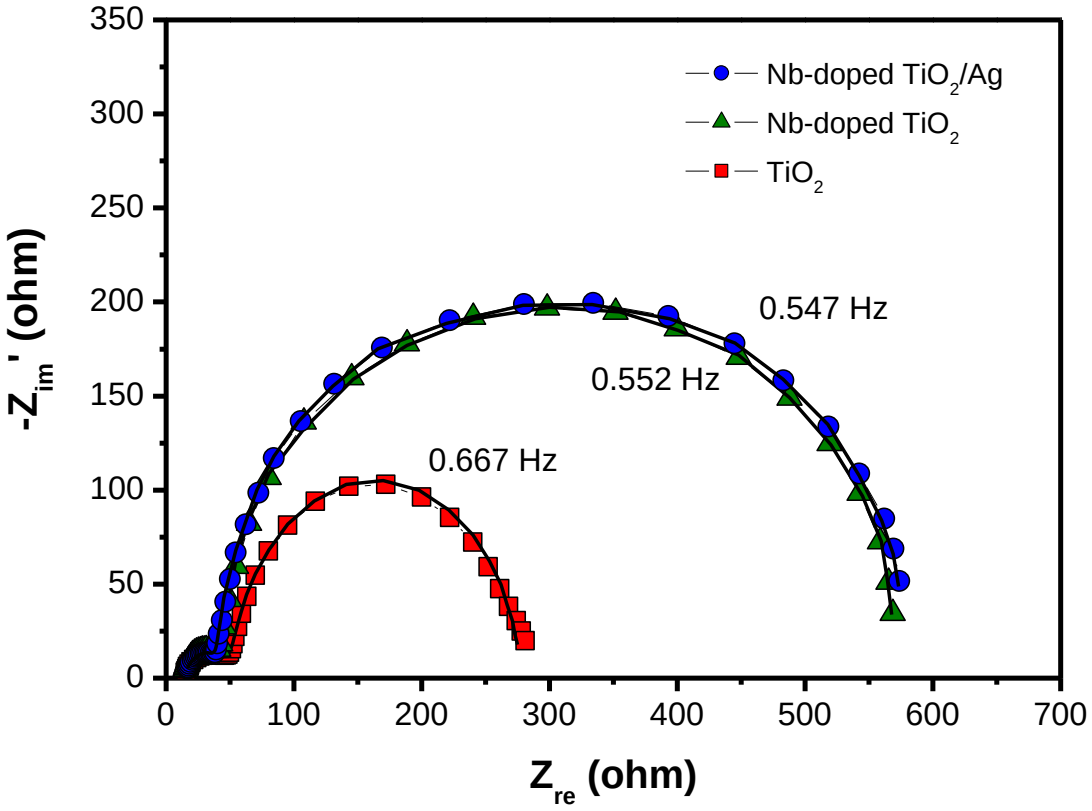


Fig. S3. EIS curves of DSSC with $TiO_2$, Nb-doped $TiO_2$, and Nb-doped $TiO_2$/Ag ternary nanostructure photoanode using a solid PEBII electrolyte measured at -0.65 V bias voltage under dark condition (100 kHz ~ 10 mHz). The fitting curves were obtained using Z-Plot software.

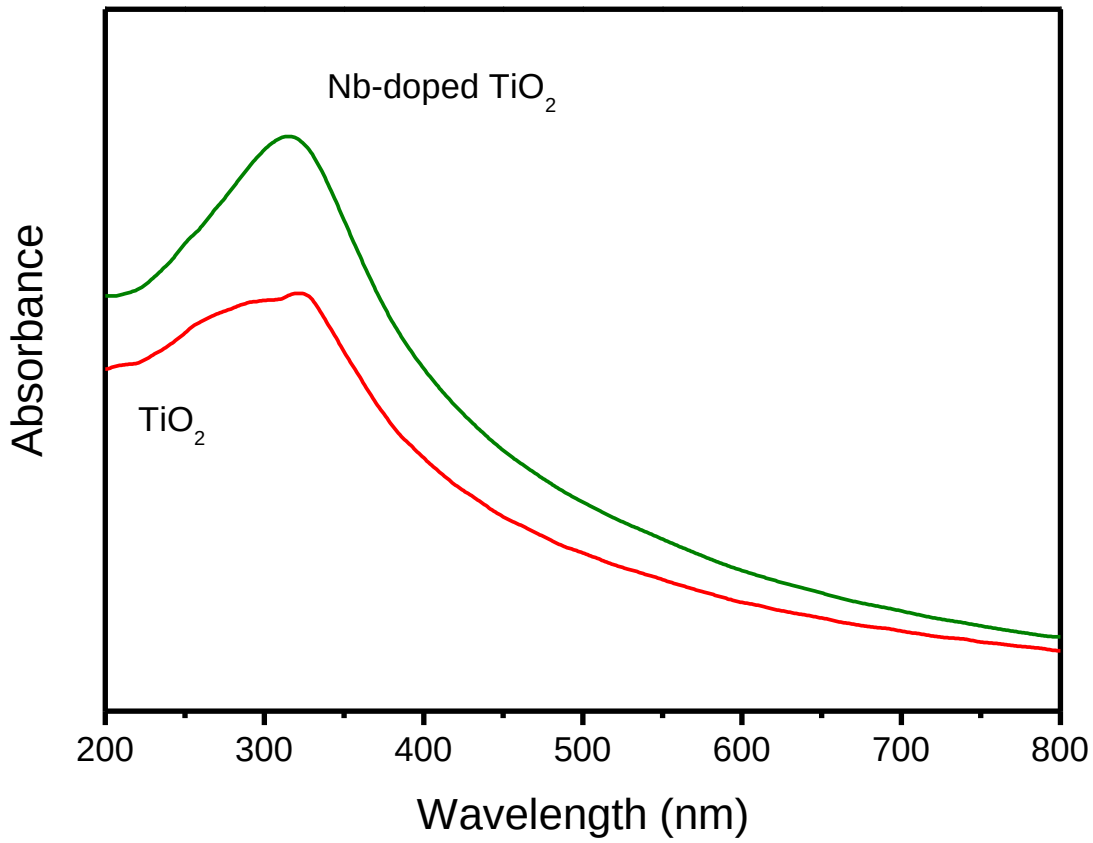


Fig. S4. Optical absorption spectra of the $TiO_2$ and Nb-doped $TiO_2$ photoanode.

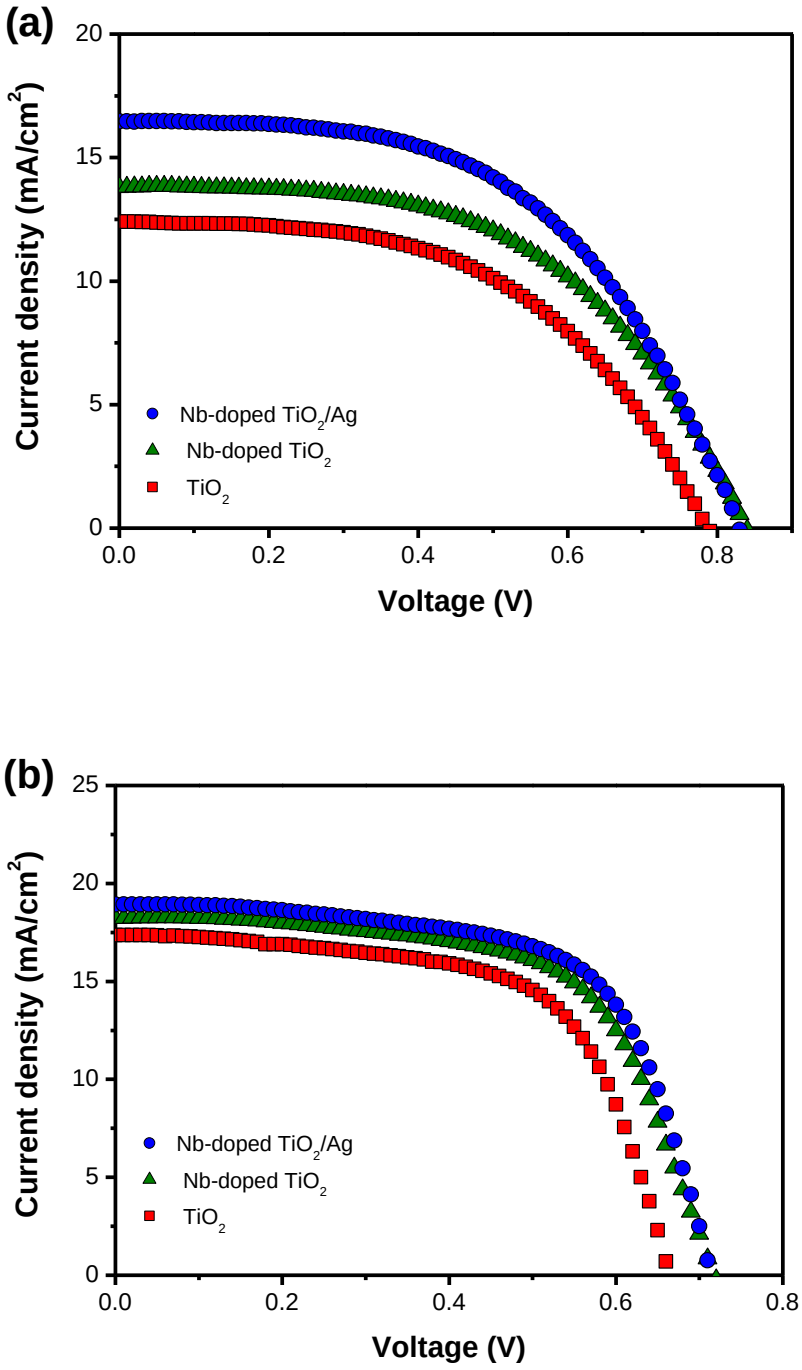


Fig. S5. *J-V* curves of DSSCs fabricated using pristine $TiO_2$, Nb-doped $TiO_2$, and the Nb-doped $TiO_2$/Ag ternary nanostructure at 100 mW/cm$^2$ upon using (a) a solid PEBII electrolyte and (b) a liquid electrolyte consisting of 1-butyl-3-methylimidazolium iodide, $I_2$, guanidinium thiocyanate, and 4-tert-butylpyridine in a mixture of acetonitrile and valeronitrile. The thickness of photoanode is approximately 14 μm.

Table S1. Photovoltaic properties of three types of DSSCs fabricated using $TiO_2$, Nb-doped $TiO_2$, and Nb-doped $TiO_2$/Ag ternary nanostructure with a solid PEBII electrolyte at 100 mW/cm$^2$. The thickness of photoanode is approximately 14 μm.

| Photoanode | $V_{oc}$ (V) | $J_{sc}$ (mA/cm$^2$) | *FF* | $\eta$ (%) |
|---|---|---|---|---|
| $TiO_2$ | 0.78 | 12.4 | 0.53 | 5.1 |
| Nb-doped $TiO_2$ | 0.83 | 13.8 | 0.54 | 6.1 |
| Nb-doped $TiO_2$/Ag | 0.82 | 16.5 | 0.53 | 7.2 |

Table S2. Photovoltaic properties of three types of DSSCs fabricated using $TiO_2$, Nb-doped $TiO_2$, and Nb-doped $TiO_2$/Ag ternary nanostructure with a liquid electrolyte of 1-butyl-3-methylimidazolium iodide, $I_2$, guanidinium thiocyanate, and 4-tert-butylpyridine in a mixture of acetonitrile and valeronitrile at 100 mW/cm$^2$. The thickness of photoanode is approximately 14 μm.

| Photoanode | $V_{oc}$ (V) | $J_{sc}$ (mA/cm$^2$) | *FF* | $\eta$ (%) |
|---|---|---|---|---|
| $TiO_2$ | 0.66 | 17.3 | 0.63 | 7.3 |
| Nb-doped $TiO_2$ | 0.71 | 18.2 | 0.64 | 8.2 |
| Nb-doped $TiO_2$/Ag | 0.71 | 18.9 | 0.65 | 8.7 |