

ACCESSORY PUBLICATION

7 Al-doped TiO₂ Photoanode for Dye-Sensitized Solar Cells8 Fuzhi Huang,^{A, B} Yi-Bing Cheng,^B Rachel A. Caruso^{A, C, D}

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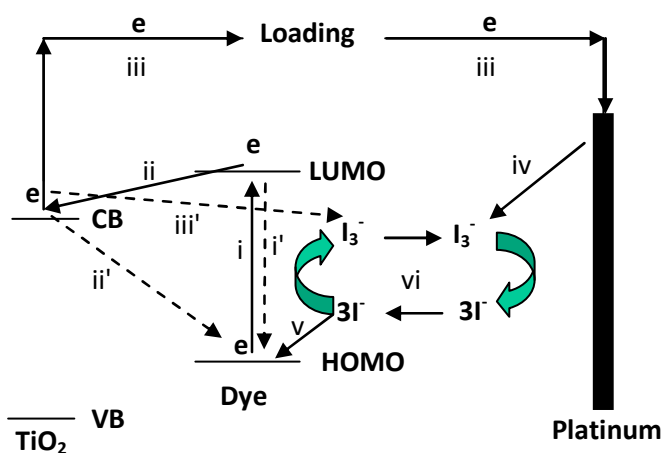
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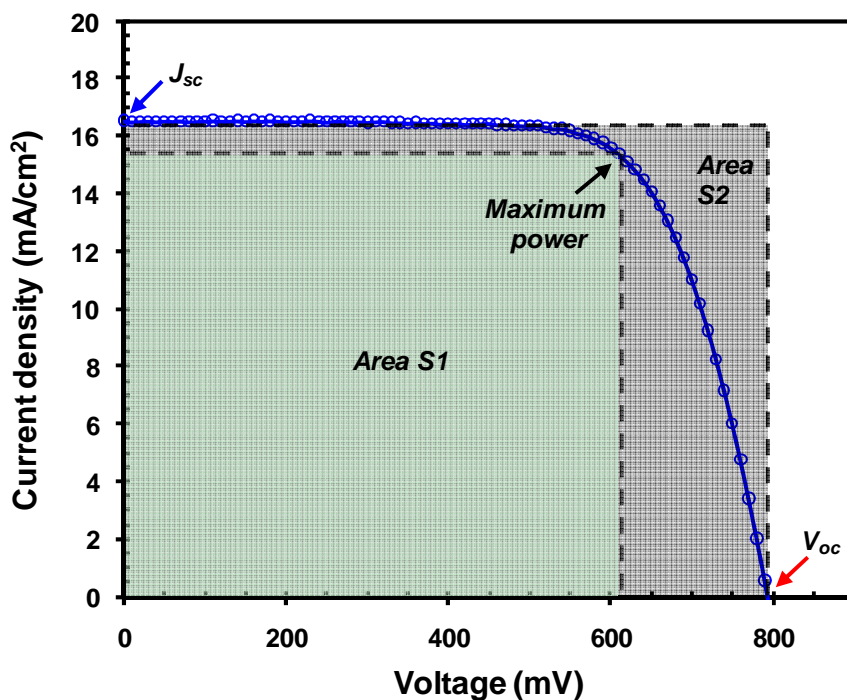
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19 **Figure S1** DSC operating principle. Here CB stands for conduction band, VB is for valence band, and
 20 e is the electron. When the device is irradiated by sunlight, the monolayer of dye molecules which are
 21 attached on the surface of the porous semiconductor (usually TiO₂) are excited. An electron in the dye
 22 HOMO (highest occupied molecular orbital) state jumps to the LUMO (lowest unoccupied molecular
 23 orbital) state (step i). These electrons can then be injected into the conduction band of the
 24 semiconductor, here represented as TiO₂ (step ii), as its energy position is lower than that of the dye

1 LUMO level. The electrons will flow along the conduction bands of the TiO₂ particles, which are
 2 sintered together, to the outer circuit and power the load (step iii). The electrons continue through the
 3 circuit to the counter electrode and via the platinum catalyst reduce tri-iodide (I₃⁻) to iodide (I⁻) (step
 4 iv). The I⁻ can then reduce the oxidized dye (step v) so that it returns to the ground state and therefore
 5 the dye can be reused to absorb light. The concentration variation between the working electrode and
 6 counter electrode drives the I₃⁻ from the working electrode to the counter electrode, while the I⁻ is
 7 driven from the counter electrode to the working electrode by diffusion (step vi). This returns the
 8 system to its starting state so that it can continuously convert the photon energy to electrical energy. In
 9 the device, there are several electron losses which should be avoided. The excited electrons may decay
 10 back to the ground state within the dye molecule (step i'). The second loss is caused by the
 11 recombination of the injected electron in the conduction band of TiO₂ and the oxidized dye (step ii').
 12 Another recombination event can occur between the injected electron and I₃⁻ (the hole), which is
 13 called the dark current (step iii').
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 17 **Figure S2** Example current-voltage curve (I-V) for determining the device parameters: the open-
 18 circuit photovoltage (V_{oc}), short-circuit photocurrent or photocurrent density (J_{sc}), and fill factor (FF).
 19 The V_{oc} , showing the maximum voltage output of the cell, can be read from the plot where current is
 20 zero. The J_{sc} indicating the maximum current output of the cell is the current at zero voltage. The FF
 21 is defined as the ratio of the actual maximum obtainable power (area S1, P_{max}) to the theoretical power
 22 (area S2, $V_{oc} \times J_{sc}$).
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