Electronic Supplementary Material (ESI) for Energy & Environmental Science

SUPPORTING INFORMATION

Dye solar cells as optically random photovoltaic media

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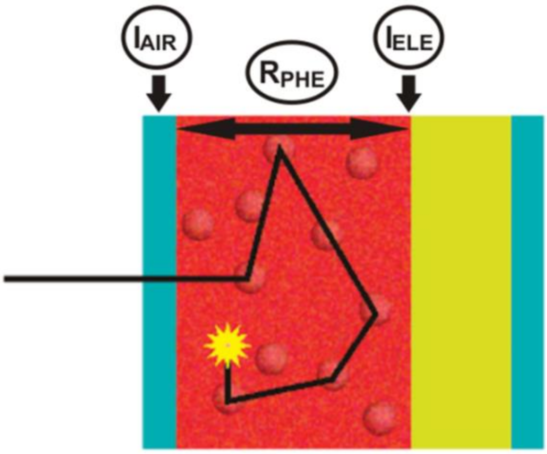

Scheme S1. A representation of the simulated DSC, in which the air-TCO entrance interface (I_{AIR}) and the exit photoelectrode-electrolyte interface (I_{ELE}) are considered. In between, the active photoelectrode region, composed of a dye sensitized nanocrystalline titania film with embedded scattering particles (R_{PHE}).

Values of all relevant electrical parameters	
Concentration of conduction band states	$N_c = 10^{20}$ cm^{-3}
Order of electron recombination	β=0.7
Diffusivity of conduction band Electrons	$D_0 = 0.4$ cm^2 s^{-1}
Conduction band energy vs redox potential of electrolyte	$E_c - E_{redox} = 1$ eV
Recombination rate constant	$kr = 4\ 10^9$ cm$^{3-\beta}$ s^{-1}

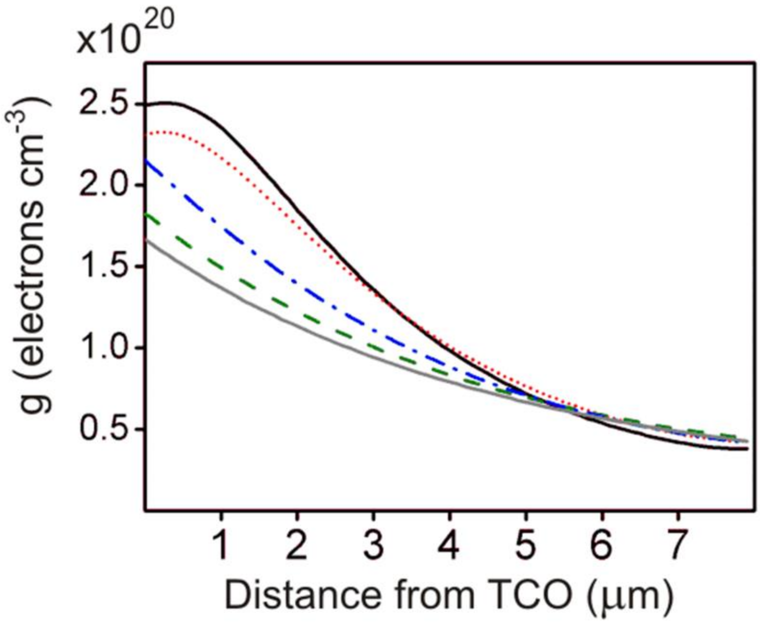

Figure S1. Examples of calculated electron generation rates for 8 micron thick dye sensitized electrodes with no scattering centres (gray solid line), containing anatase scattering particles (black solid line), electrolyte filled cavities (red dotted line), silver particles (blue dashed dotted line), and gold particles (green dashed line). In each case, particle size and concentration is that that optimizes the cell performance.

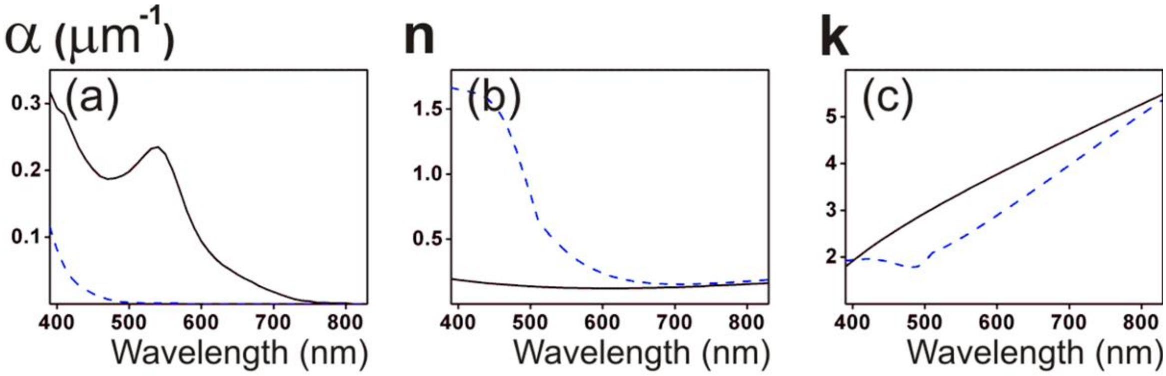

Figure S2. Optical constants employed in the calculations for the different materials considered. (a) Absorption coefficients for dye filling DSC porous (continuous line) and bulk electrolyte (dashed line); (b) real and (c) imaginary parts of the refractive index of silver (solid line) and gold (dashed line).

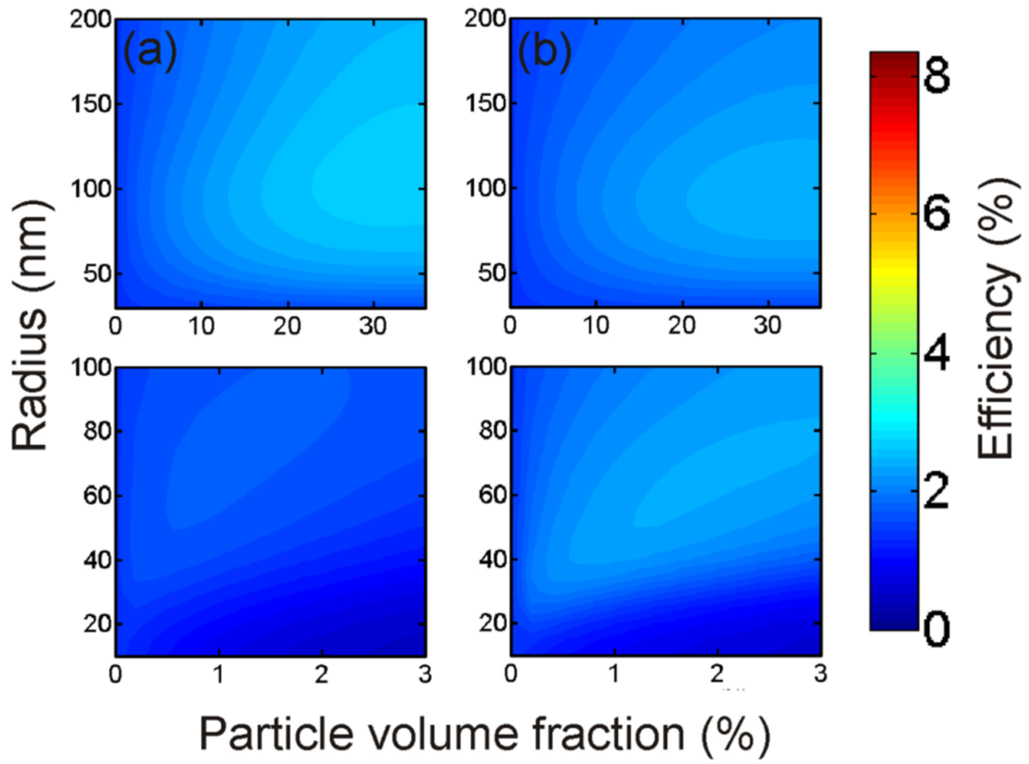

Figure S3. Power conversion efficiency versus sphere radius and volume fraction for electrodes of 1 micron thick electrodes including (a) titania, (b) electrolyte filled cavities, (c) gold, and (d) silver particles.

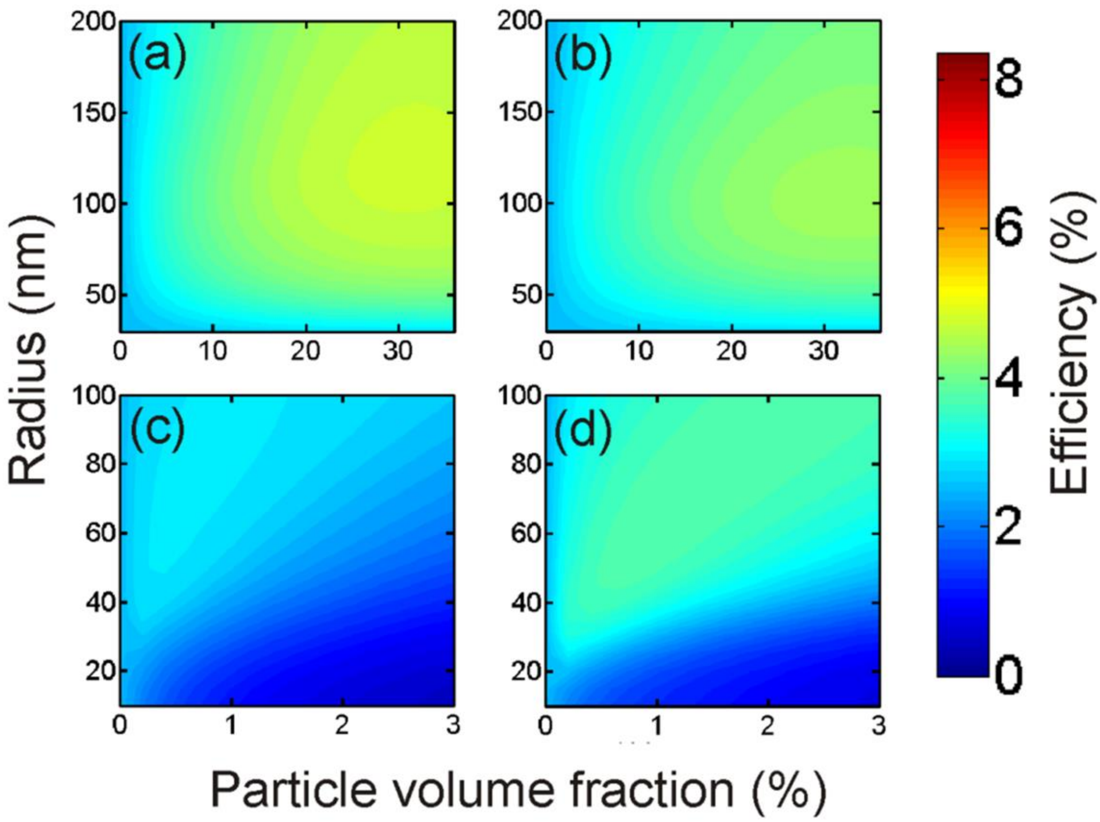

Figure S4. Power conversion efficiency versus sphere radius and volume fraction for electrodes of 2 micron thick electrodes including (a) titania, (b) electrolyte filled cavities, (c) gold, and (d) silver particles.

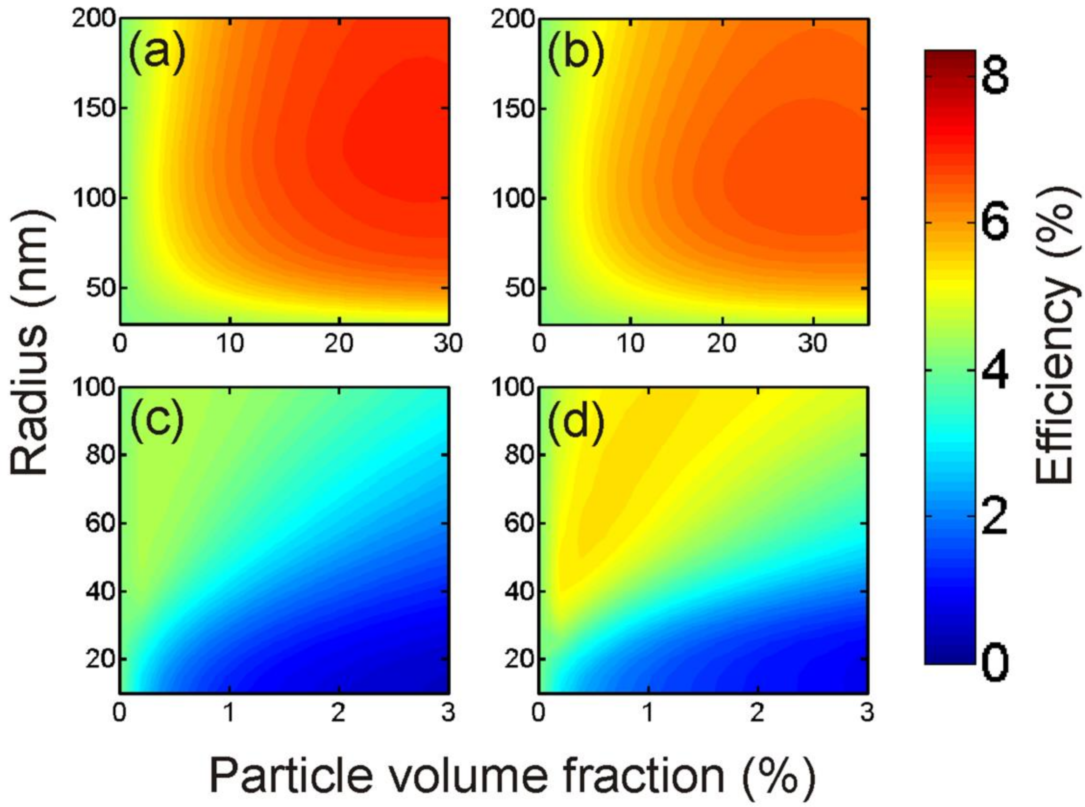

Figure S5. Power conversion efficiency versus sphere radius and volume fraction for electrodes of 4 micron thick electrodes including (a) titania, (b) electrolyte filled cavities, (c) gold, and (d) silver particles.

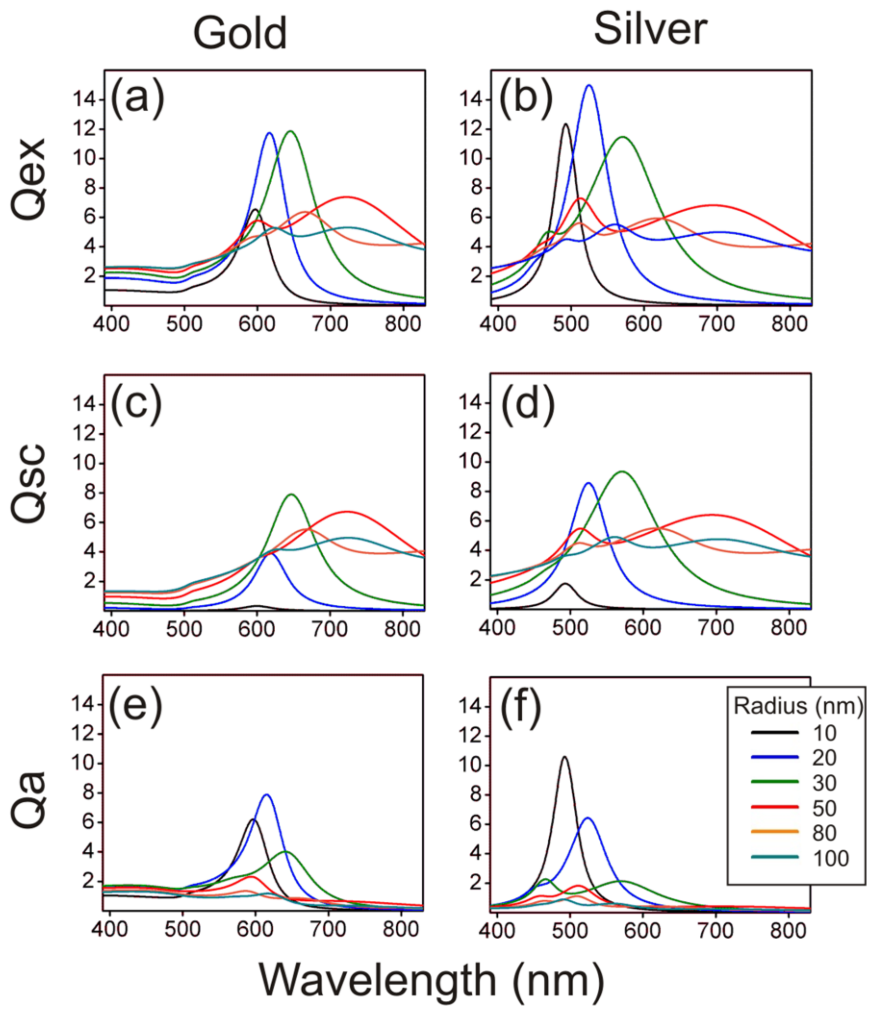

Figure S6. From top to bottom, extinction (total), scattering and absorption cross sections for (a) silver and (b) gold particles as a function of wavelength. Different particle radius are considered, as indicated in the legend.

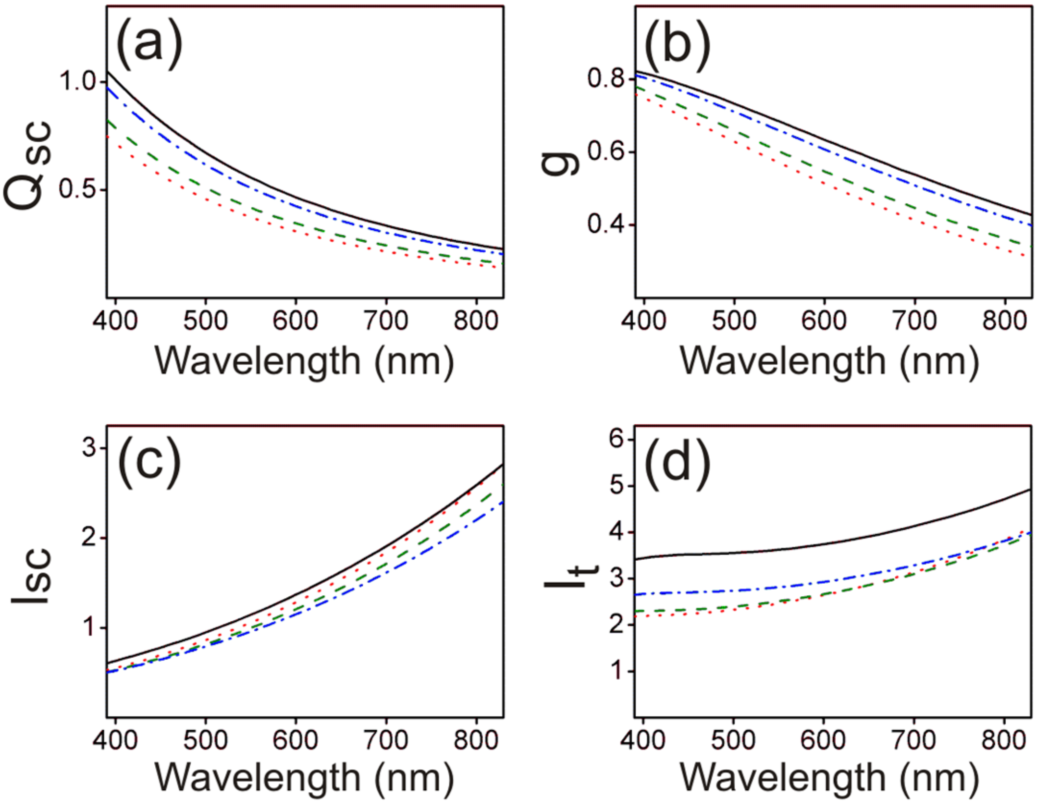

Figure S7. (a) Scattering cross section (Q_{sc}), (b) average of the scattering angle (g), (c) scattering mean free path (lsc), and (d) transport mean free path (lt) for nanocrystalline titania electrodes including electrolyte filled cavities. Electrode thickness are *d*=1 μm (red dotted line), *d*=2 μm (green dashed line), *d*=4 μm (blue dashed dotted line) and *d*=8 μm (black solid line). Particle size and concentration are such that optimize light harvesting and thus power conversion efficiency in each case (see Table 1).

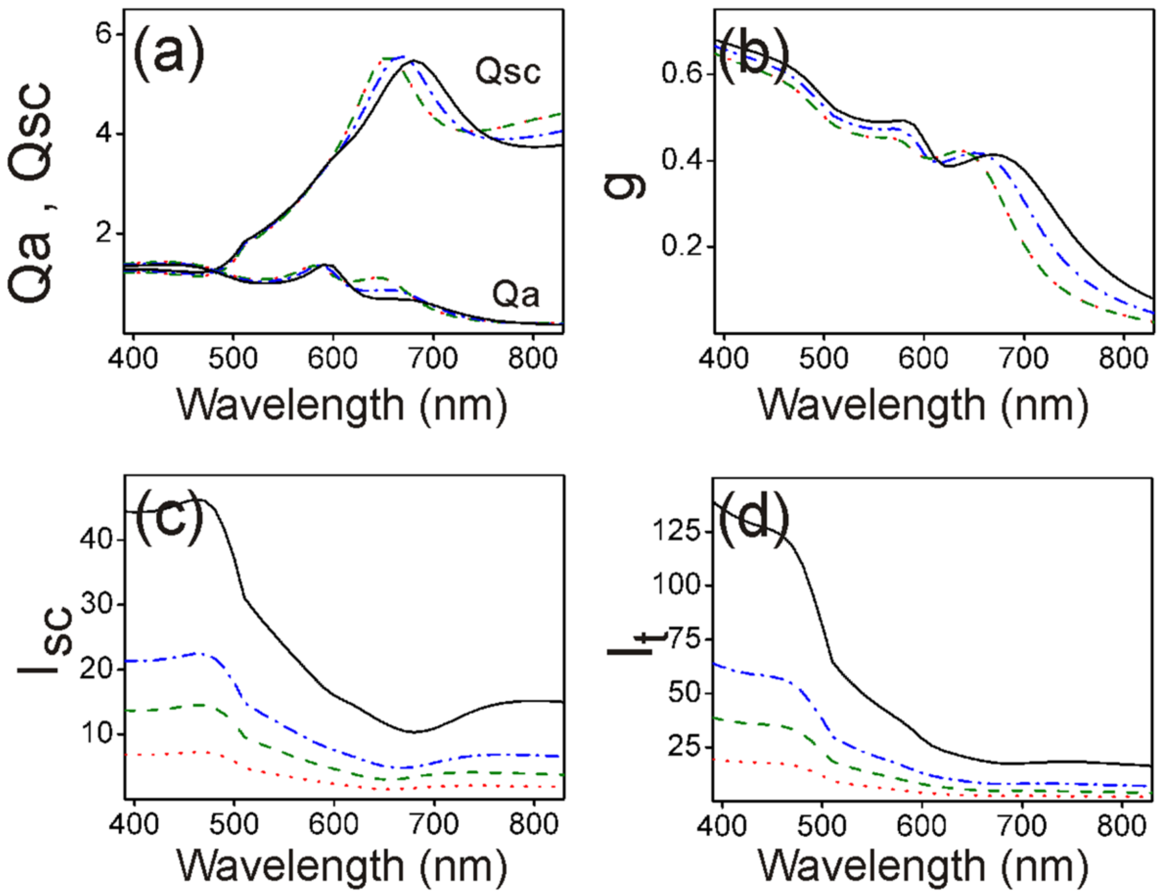

Figure S8. (a) Scattering and absorption cross sections (Q_{sc}, Q_a), (b) average of the scattering angle (g), (c) scattering mean free path (lsc), and (d) transport mean free path (lt) for nanocrystalline titania electrodes including gold particles. Electrode thickness are *d*=1 μm (red dotted line), *d*=2 μm (green dashed line), *d*=4 μm (blue dashed dotted line) and *d*=8 μm (black solid line). Particle size and concentration are such that optimize light harvesting