Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information

Selective Laser Sintering of TiO_2 nanoparticles Film on Plastic Conductive Substrate for Highly Efficient Flexible Dye-sensitized Solar Cell Application

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The video in the supporting information shows the bending test of the cold isostatic pressed TiO_2 nanoparticles film on ITO/PEN substrate. The embedded patterns are laser treated regions. The adhesion between the TiO_2 film, whether or not treated by laser, and the ITO/PEN substrate are both good. You would also see that the film cannot be easily peeled off by finger touch.

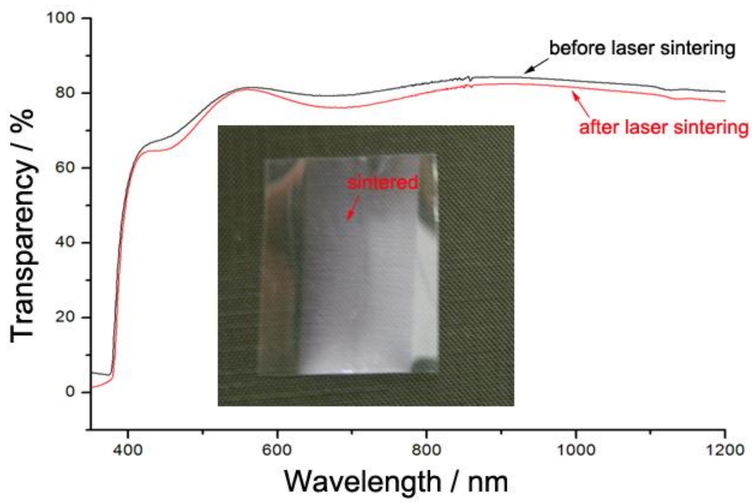

Figure S1. Optical transparency of ITO/PEN film before and after laser sintering. The inset is the optical image of the corresponding film.

The optical transparency keeps nearly unchanged. The sheet resistance was tested to be 14.3 and 14.8 Ω sq^{-1}, also unchanged before and after laser sintering. These phenomena reflect the laser sintering has caused no damage to the plastic conductive substrate.

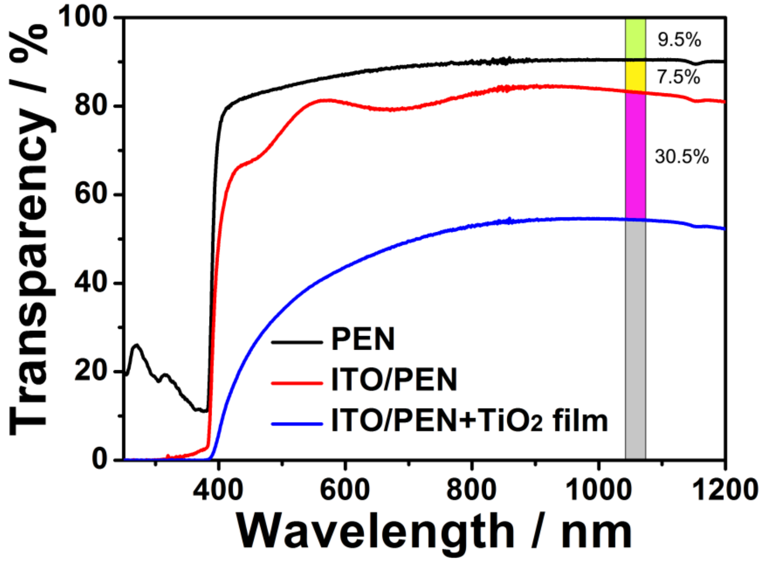

Figure S2. Comparison on optical transparency of differnet layer. The 13 μm thick TiO_2 film, the ITO coating on PEN, and the PEN substrate harvest 30.5%, 7.5% and 9.5% of 1064 nm wavelength light, respectively.

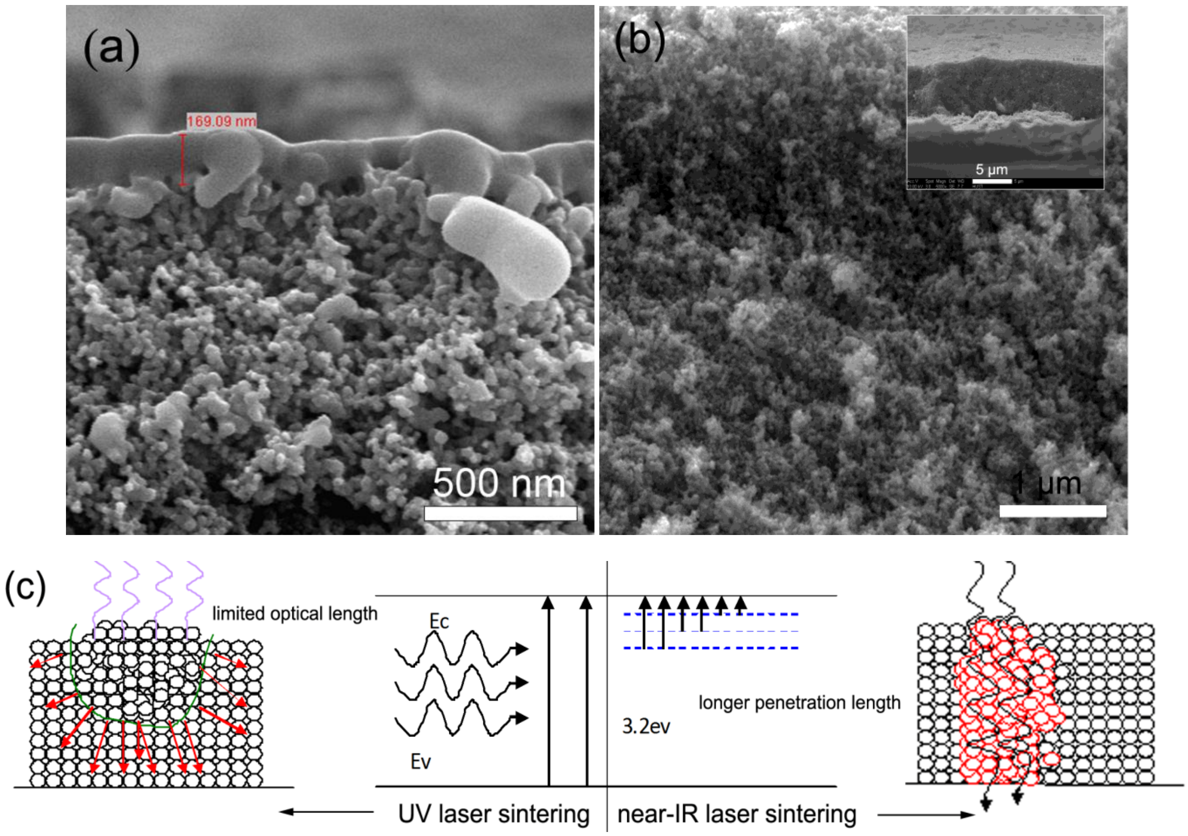

Figure S3. Different sintering effect on TiO_2 nanoparticles films depend upon different laser sources: (a) UV laser (355 nm), (b) near-IR laser (1064 nm), and (c) their proposed light absorption mechanisms.

The UV light is absorbed strongly by the TiO_2 film, which just act on an ultrathin top layer (100-200 nm). The near-IR light absorption by the TiO_2 film, associated with intra band-gap energy levels related to oxygen vacancies, is relatively weak in comparison to indirect inter-band photon absorption of UV light. Therefore, near-IR light has longer penetration length across the whole film thickness (10 μm). The sintering effect should be more gentle and homogenous across the whole film thickness.

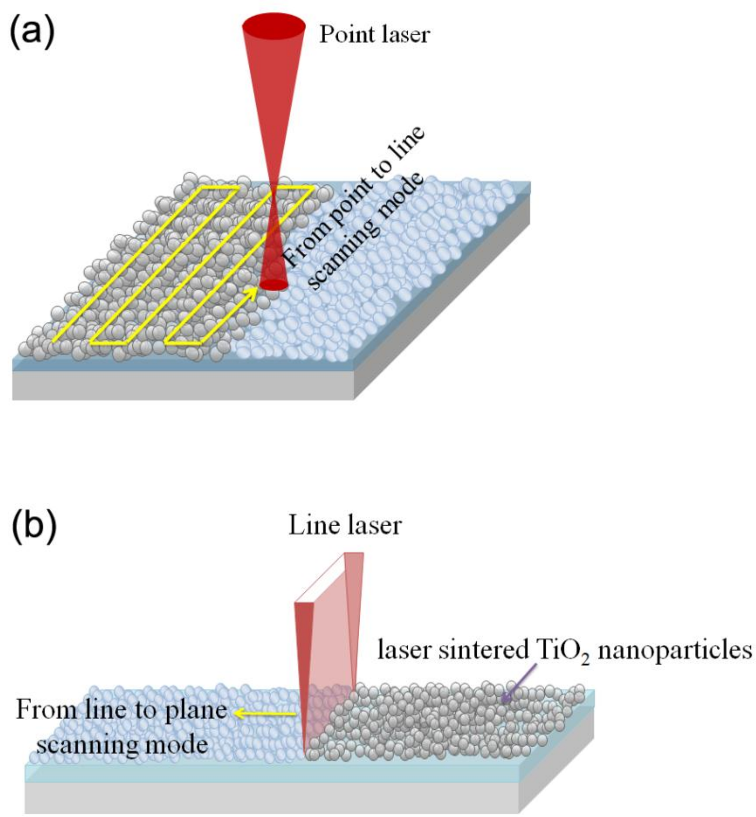

Figure S4. Schematic show laser sintering of the TiO_2 nanoparticles films by (a) point laser with "from point to line" scanning mode and (b) line laser with "from line to plane" scanning mode. The production rate could be dramatically increased by using a line laser source.

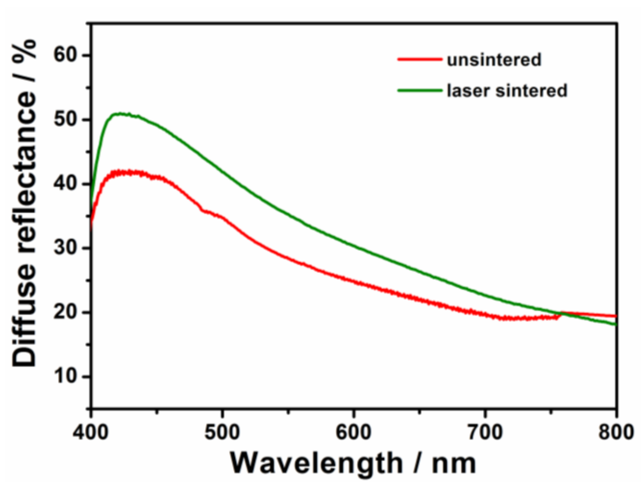

Figure S5. Diffuse reflectance spectra of the TiO_2 nanoparticles films (a) before and (b) after laser sitnering.