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Electronic Supporting Information

Fabrication and characterization of plastic-based dye-sensitized solar cells consisting of crystalline mesoporous titania nanoparticles as photoanodes

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Characterization of MTNs and P90

Figure 1(a) shows XRD patterns of MTNs (before and after hydrothermal treatment (HT)) and commercial TiO_2 nanoparticles P90. It can be clearly seen that the phase of MTNs changed from amorphous to anatase after HT treatment. All diffraction peaks shown in Figure S1(a)-II can be indexed to TiO_2 anatase phase, according to Joint Committee on Powder Diffraction standards (JCPDS, PDF no. 21-1272). It can also be noted that the XRD pattern of HT-treated MTNs was similar

to that of P90. The crystalline sizes of anatase for MTNs and P90 NP were ca. 12.5 nm and 15.9.0 nm, respectively, estimated from the most intensive peak in the Figure 1(a) using the Scherrer equation:

$$d = \frac{K\lambda}{\beta \cos\theta} \tag{1}$$

where K is the shape factor, λ is the X-ray wavelength, β is the line broadening at half the maximum intensity (FWHM) in radians, and θ is the Bragg angle. d is the mean size of the ordered (crystalline) domain, which may be smaller or equal to the grain size. The dimensionless shape factor K has a typical value of about 0.9, and λ is 0.1514 nm for the present study.

The porous properties of the products were analyzed using N_2 adsorption/desorption isotherms on a Micromeritics ASAP 2000 instrument. Samples were degased at 100 °C overnight before N_2 adsorption. Specific surface area was evaluated using the Brunauer-Emmett-Teller (BET) method at P/P_0 = 0.14-0.99, and the average pore size was calculated from the desorption isotherm using the Barret-Joyner-Halenda (BJH) method, as shown in Fig. S2. The BET specific surface area for the MTNs and P90 were calculated at P/P_o = 0.19858 with 132.7042 $m^2\ g^{-1}$ and at P/P_o = 0.20022 with 91.3 $m^2\ g^{-1}$, respectively. MTNs exhibited a typical type

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IV isotherm, representing an adsorption on mesoporous solids via multilayer adsorption followed by capillary condensation. The adsorption process at low relative pressures was similar to that on macroporous solids, but the adsorption amount increased steeply at high relative pressures because of the capillary condensation in mesopores. The specific surface area and pore size for MTNs were calculated to be 132.7 m^2 g^{-1} and 11.2 nm, respectively. In constrast to MTNs, P90 exhibited a relative low surface area of 91.3 m^2 g^{-1} and no porous structure. The TEM image of MTNs in Fig. S2(a) clearly evidences that each MTN is composed of many primary TiO_2 anatase nanocrystallites. In contrast, the TEM image of P90 in Fig. S2(b) shows that P90 is composed of merely primary TiO_2 nanocrystallites.

Results

Fig. S1

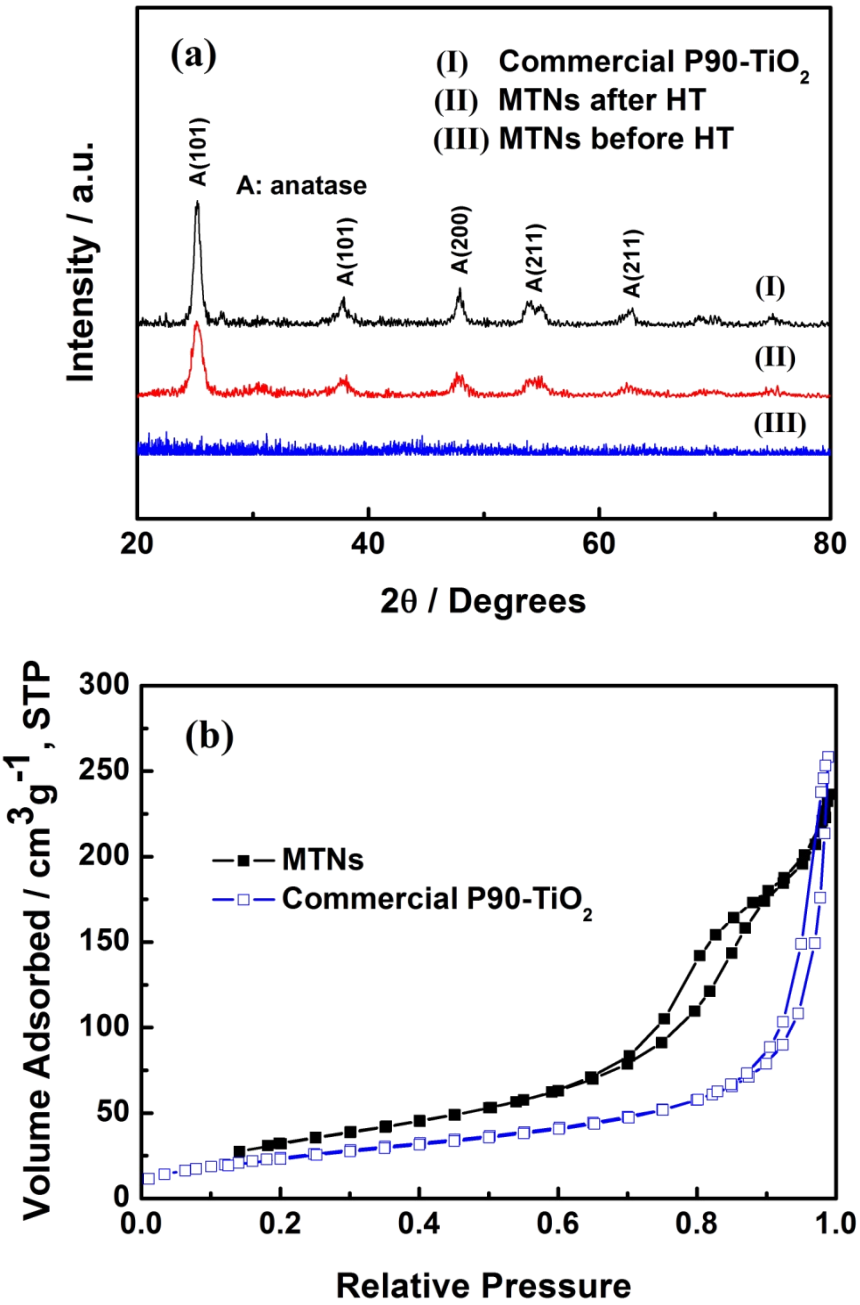

Fig. S1 (a) XRD patterns and (b) nitrogen adsorption-desorption isotherms for P90 TiO_2 nanoparticles and MTNs (before and after hydrothermal treatment).

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Fig. S2

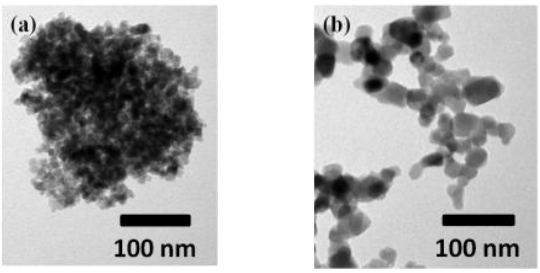

Fig. S2 TEM images for (a) MTNs and (b) P90 NP.