Supporting Information

Growth of Titanium Dioxide Nanorods in 3D-Confined Spaces

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S1. (a) SEM image of the cross-section of the AAO template. (b) SEM image of the bottom portion of the AAO template, where the AAO channels become a little narrower and channel bifurcation or termination appears. In general, the AAO templates are ~53-54 μm long. The channels in the AAO template are ~250 nm in diameter. The average aspect ratio of the AAO channels is ~200.
S2: Length and width distribution of the TiO$_2$ nanorods along the AAO channel. The data were collected from the TiO$_2$ nanorods grown by 660 cycles.
S3: (a) XRD spectrum of the TiO$_2$ nanorods grown in AAO template. (b) EDS spectrum of the TiO$_2$ nanorods.
S4. (a) Length and (b) width analysis of the TiO$_2$ nanorods grown by different cycles. Both length and width exhibit a uniform distribution along the entire AAO channel and are rarely dependent on the positions. This is a distinguishing merits comparing to other nanostructure growth techniques.
S5: Anatase TiO$_2$ nanoparticles. (a) SEM image of the top surface of an AAO template after 900 cycles. Pulse and purge time are 1.5 s and 60 s, respectively. No nanorod morphology was observed on the top surface but only nanoparticles. (b) HRTEM image of an TiO$_2$ nanoparticle obtained from the top surface. It is surrounded by $\{011\}$ side surfaces. (c) Fourier transformation image of the HRTEM in (b) confirms the orientation and the anatase phase.
S6: SEM images of anatase TiO$_2$ grown via the same pulsed CVD procedure (660 cycles at 600°C). (a) On a flat polycrystalline Al$_2$O$_3$ substrate. (b) On an open AAO channel surface. Nanoparticle became the dominating morphology indicating confined space is favorable for nanorod formation.
S7: Confirmation of the anatase phase of the TiO$_2$ NRs with diffraction patterns and high-resolution images from two different zone axes of the same NR. (a) The NR aligned along the [111] zone axis. (b) The same nanorod aligned along the [711] zone axis. Both diffraction patterns and the high-resolution lattice images match well with the standard anatase TiO$_2$ crystal.
S8: HRTEM images of the side and tip of an anatase TiO$_2$ nanorod.  
(a) Side surface showing flat and stepless (011) atomic plane.  
(b) Tip surface showing multiple steps on the (001) atomic plane.
**S9:** HRTEM images of an anatase TiO$_2$ nanorod tip. The line fringes on the top-left corner of the nanorod tip indicates different thickness comparing to other region of the tip, where a 2D lattice can be clearly observed. This image suggests that the unevenness also appears along the [100] direction, which is the direction perpendicular to the image plane.
**S10:** (a) Bright field and (b) dark field TEM images of a TiO$_2$ nanorod growth by 330 cycles; where the tips are not well facetted. (c) HRTEM image of a TiO$_2$ nanorod growth by 170 cycles. It exhibits a non-facet growth front of but well defined side surfaces.
S11: Planar defects observed on an anatase TiO$_2$ nanorod. (a) TEM image showing several planar defects along the (001) plane, as indicated by the arrows. (b) HRTEM image of one planar defect. The formation of such planar defects was a very rare case. Most NRs observed under TEM did not show such dislocations.