Phase Tuned TiO_2 Nanotubes for Enhanced Photocatalytic Hydrogen Generation: Anatase → Anatase-Rutile → Anatase-Rutile-Brookite.

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TiO_2 is a well known photocatalyst for wide applications such as water splitting, pollutant degradation, solar cell etc due to its high chemical stability, band level positioning, and abundant availability. However, the material absorbs only the UV part of sunlight, and suffers high electron-hole recombination rate which needs substantial improvement. Among various modifications adopted, the mixed phase TiO_2 is widely recognized due to the efficient electron-hole pair separation, which results in an enhanced photocatalytic activity, when compared to single phase TiO_2. Even though there are many literatures reporting the synthesis of TiO_2 mixed phases and their enhanced photocatalytic activity, development of more facile and simple methods for the synthesis of tunable phase-junction TiO_2 is still under progress. Herein, we report a novel synthesis method to prepare anatase, anatase-rutile and anatase-rutile-brookite heterojunctions porous TiO_2 nanotubes by simply tuning the voltage in electrochemical anodization technique. The phase evolution with respect to voltage is confirmed by the X-ray diffraction analysis. It is observed that the anatase-rutile-brookite phase junction TiO_2 nanotubes are highly efficient compared to anatase-rutile or anatase TiO_2 nanotubes in hydrogen generation by water splitting. The results suggest that the anatase-rutile-brookite having two junction interfaces highly facilitate inter-particle charge transfer due to the synergistic effect among the phases compared to single junction anatase-rutile or bare anatase TiO_2 nanotubes. This opens a pathway for the simple synthesis and study of tri-phase TiO_2 for efficient photocatalytic water splitting.