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Photoluminescence and Hydrogen Gas-Sensing Properties of Titanium Dioxide Nanostructures Synthesized by Hydrothermal Treatments

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ABSTRACT:Titanium dioxide (TiO2) nanostructures were synthesized by microwave-assisted and conventionally heated hydrothermal treatment of TiO2 powder. The tubular structures were converted to a rodlike shape by sintering the samples at various temperatures in air for 3 h. This was accompanied by phase transformation largely influenced by the method of synthesis and the mode of heating. The X-ray diffraction results are in agreement with the structural transformation indicating the gradual changes in the phase and crystallinity of the as prepared samples. The tubular structure is found to collapse at high temperature. UV−vis−IR spectroscopic results suggest that nanorods tend to absorb photons of higher energy (λ= 280 nm) than nanotubes (λ= 300 nm) but emit photons with lower energy than nanotubes. It was found that the nanotubes have a sharper photoluminance emission line at 340 nm that is absent in the nanorods. We also found that nanotubes have higher efficiency, lower threshold sensing temperature, longer response time, and shorter recovery time for hydrogen gas sensing than nanorods.