WO_3 AND W_2N NANOWIRE ARRAYS FOR PHOTOELECTROCHEMICAL HYDROGEN PRODUCTION

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Photoelectrochemical splitting of water is one of the cleanest ways of producing hydrogen. However, with the currently used materials, efficiency of this process is less than 1%. Improvement in the electrode performance is limited by either chemical instability or poor light absorption properties of these materials. Although transition metal oxides are relatively stable during gas evolution, they have a high band gap and thus absorb only UV part of the solar spectrum. Hence there is a intense search for newer materials with improved chemically stability and optical properties. In this work, we performed post synthesis nitridation of oxide nanowire arrays to form a completely new nitrided phase which has a lower band gap.

Tungsten oxide nanowire arrays were synthesized by hot filament CVD on both FTO and quartz substrates. Figure 1 shows the SEM image of WO_3 array on FTO substrates. Post synthesis nitridation in ammonia resulted in the complete phase transformation to W_2N. X-ray diffraction and transmission electron microscopy confirmed their high degree of crystallinity.

Figure 2 shows the Tauc plot obtained from UV-Vis spectroscopy. Oxidized WO_3 has a band gap of 3 eV. On the other hand nitridation leads to a reduction in the band gap from 3 eV to 2.5 eV. The photoelectrochemical measurements were done in a three electrode configuration. Figure 3 shows a representative I-V characteristics of WO_3 in dark and under simulated AM 1.5 solar light. The electrodes were further characterized by impedance, and photocurrent spectroscopy. The results are discussed in terms of their water splitting efficiency.

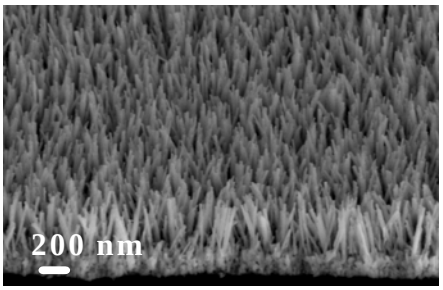

Fig 1. SEM image of WO_3 nanowire array. Post synthesis nitridation to W_2N showed no change in the morphology.

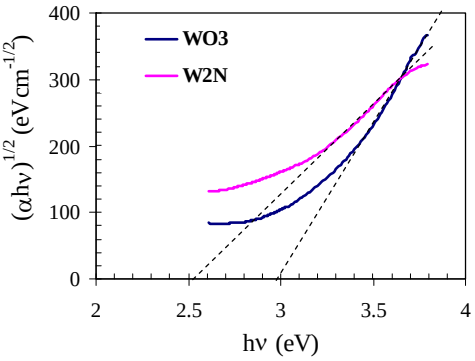

Fig 2. UV Vis data showing a reduction in the band gap from 3.0 eV to 2.5 eV upon nitridation.

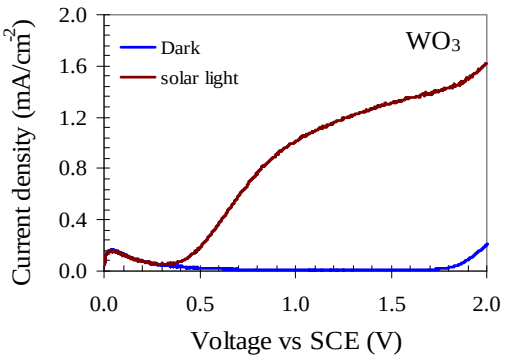

Fig 3. I-V characteristics in dark and under AM 1.5 solar light.