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MS-1-P-2892 Microstructure Study of $W_{1-x}Mo_x O_3$ 0.33H_2O for Tunable Wavelength Absorption

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Hydrated tungsten oxide WO_3 0.33H_2O has been studied extensively due to its electronic and optoelectronic properties, it has has an enormous potential application ranging from condensed-matter physics to solid-state chemistry [1], such as photo-electrochemical energy conversion, gas sensors, photocatalysis, lithium-ion batteries, solar cells [2]. Tremendous effort has been dedicated to the synthesis, solid solution mechanism and property investigation of $W_{1-x}Mo_x O_3$ 0.33H_2O over the past years. This material showed improved electrochromic, gas sensing, catalytic, lithium ion transport, and photocatalytic properties [3] when compared with their single oxide WO3 and MoO_3. Recently, Zhou et al. were capable of modulate the band gaps of the $W_{1-x}Mo_x O_3$ 0.33H_2O materials with different Mo/W ratio values [4]. We synthesized a series of $W_{1-x}Mo_xO_3$ 0.33H_2O nano/microstructures with controlled stoichiometry (x = 0, 0.25, 0.50, 0.75). With gradual increase of Mo content, we narrowed the band gap from 2.61 to 2.10 eV. This result is better than Zhou et al. but in our case, we use friendly to the environment chemical precursors such as ammonium heptamolybdate and ammonium metatungstate instead of metal powders.
Figure 1a shows a SEM image for orthorhombic WO_3 • 0.33H_2O, the particles have an average length and wide of 100 and 50 nm respectively. Figure 1b is a bright field TEM image and inset is the SAED pattern for the $W_{75}Mo_{25}O_3$ 0.33H_2O compound, the diffraction spots were to the orthorhombic structure and it has [3,0,-1] zone axis, which is a single crystal. Figure 1c corresponds to TEM image of solid solution $W_{50}Mo_{50}O_3$ 0.33H_2O and its corresponding SAED pattern which indexed to orthorhombic structure too, with [2,-1,0] zone axis, this pattern was from a particle labeled with Z1. In the case of this compound, there is different size of particles which measurements are 160nm length and 80nm width. Figure 1d shows SEM image of the compound $W_{25}Mo_{75}$O3 • 0.33H_2O. It can be notice hexagonal flake-like particles with lengths of ~150nm and widths of ~70nm.
We were able to measure and characterize our compounds with advanced microscope techniques such as SEM and TEM getting information about structure by SAED patterns where we were capable to index all spots and determine the zone axis and figure out all crystalline path growths of these type materials.

References

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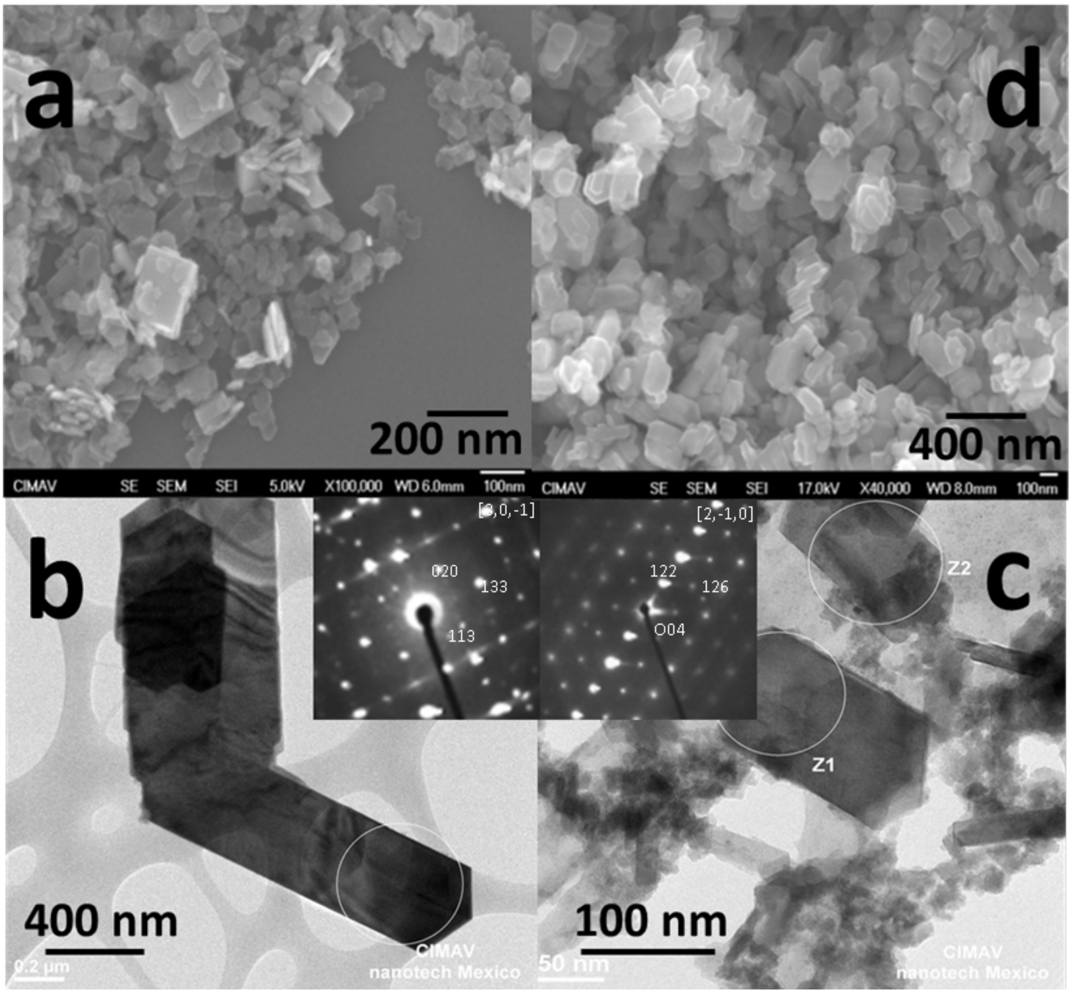

Fig. 1: FIG. 1 SEM, TEM and SAED images of $W_{1-x}Mo_xO_3 \cdot 0.33H_2O$ (x = 0, 0.25, 0.50, 0.75) nano/microstructures