$W_{1-x}Mo_xO_3 \cdot 0.33H_2O$ Solid Solutions with Tunable Band Gap for Hydrogen Production

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ABSTRACT

A series of $W_{1-x}Mo_xO_3 \cdot 0.33H_2O$ (x = 0, 0.25, 0.50, 0.75) nano/microstructures and $MoO_3 \cdot 0.55H_2O$ microamorphous structures have been prepared by hydrothermal synthesis starting from aqueous hydrate ammonium metatungstate ($(NH_4)6H_2W_{12}O_{40} \cdot xH_2O$) and tetrahydrate ammonium heptamolybdate ($(NH_4)_6Mo_7O_{24} \cdot 4H_2O$) acidified solutions. The $WO_3 \cdot 0.33H_2O$ lattice can be substituted with Mo up to 75% without structural alterations of the orthorhombic host structure. With the increase of the Mo content (x) from 0 to 0.75, the band gap of the as-prepared $W_{1-x}Mo_xO_3 \cdot 0.33H_2O$ nano/microstructure is narrowed from 2.74 to 2.31 eV. The increased M^{5+} (M = Mo and W) fraction and thus enhanced intervalency-transition are responsible for the narrowing of the band gap and presumably making hydrogen production feasible through the photocatalytic water splitting.

Keywords: H_2 production; water splitting; W/Mo solid solutions.