Evaluating the Selectivity and Activity of Mixed Molybdenum and Tungsten Oxide as Photocatalytic Carbon Converters

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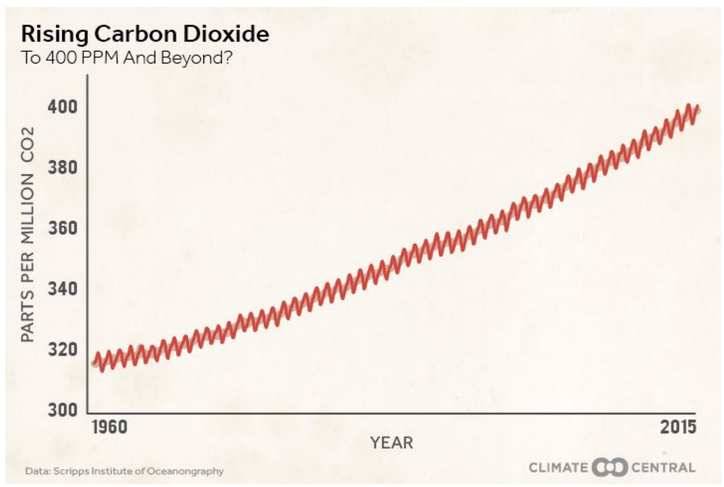
Research Question

Can Mixed Molybdenum and Tungsten Oxide act as a viable photocatalyst for use in atmospheric carbon dioxide reduction?

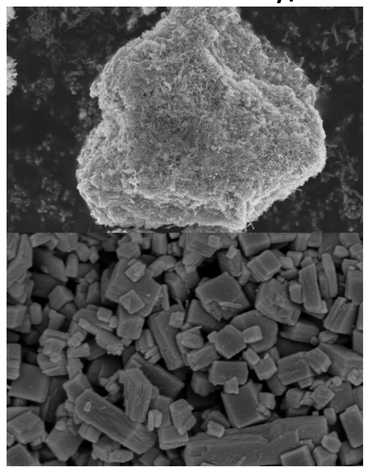
Motivation

- Rapidly increasing levels of atmospheric carbon dioxide present an urgent problem
- Photocatalysis harnesses free and plentiful solar energy
- Semiconductors from group VI have tunable characteristics that enable more efficient photocatalysis
- Carbon conversion allows for economic practicality and scalability of the process



Methodology

- Utilized solvothermal synthesis, a chemical reaction involving high temperatures and pressures in an autoclave
- General method followed was to mix precursors in a solution via a magnetic stir bar, heat in an oven over many hours, centrifuge to isolate mixed compound, and then dry under vacuum.
- Parameters varied across all syntheses include type of solvent(H2O/HCl/H2O2/Isopropanol), length of heat treatment(6/12 hrs), utilized precursors(metal powders/ammonium hydrates), and pH(2-3/6-7)
- Determined the structure and morphology of the mixed compound using spectroscopy/microscopy
- Analyzed the performance of the reaction via gas chromatography to calculate activity/selectivity

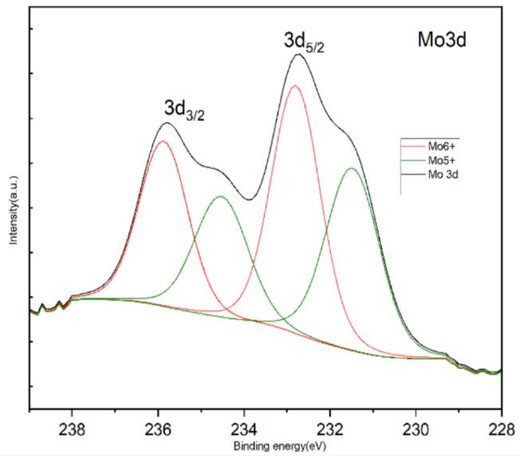


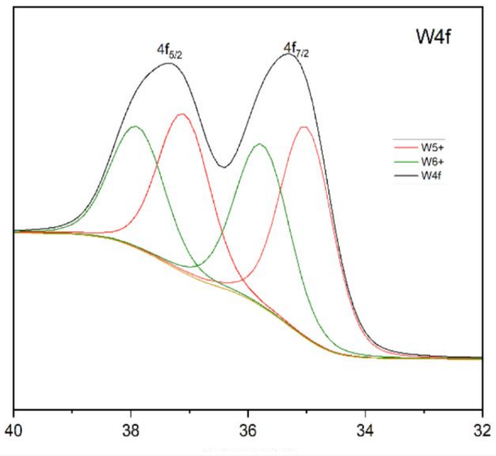
Findings and Progress

- The mixed compound were synthesized dozens of times to optimize production.
- XPS revealed a mix of oxidation states for both Mo and W, +5 and +6 for both.
- SEM revealed that the mixed compound can be synthesized to have the morphology of nanowires or nanoplates

Future Work

- Investigating long-term stability and degradation of the photocatalyst in use
- Analysis of the economics of scale, production, and implementation
- Further research into optimization of all free parameters





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