Nanoflower-Like Bi_2MoO_6/Ag_3PO_4 in Water Treatment

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Introduction:

- Environmental issues continue to intensify causing natural resources such as clean water to become increasingly scarce while demand only continues to grow.
- Some of the most effective measures taken appear to be bioremediation tactics and their synthetic counterparts.
- A critical area of interest are semi-conducting photocatalytic nanomaterials that take advantage of the photo-electric effect and use the introduction of ultra violet (UV) and visible light to induce oxidation and reduction reaction in p-type semiconductors. This results in the decomposition of certain pollutants and/or deactivates certain microbes in water.
- These materials have the potential to operate using only light emitted from the sun, thus being free from the need for an external bias.

Purpose:

- Due to the relationship between surface area and photocatalytic ability, the purpose of this study is to design a nanoflower configuration of Bi_2MoO_6/Ag_3PO_4 and further improve upon an already impressive z-scheme photocatalyst targeting the organic pollutant methylene blue.

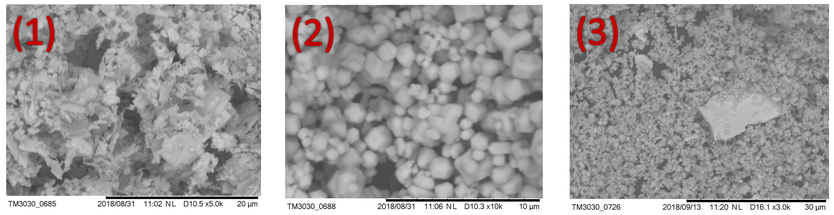
Methods:

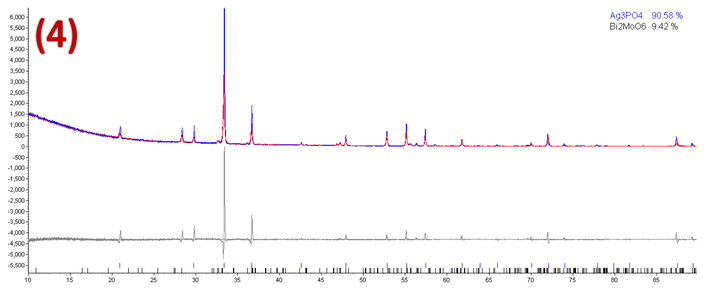
- To assess the photocatalytic ability of nanoflower-like Bi2MoO6/Ag3PO4 in removing methylene blue (MB), a 30 mL polluted test sample was prepared for every material at a concentration of 8 mg/L. 30 mg of photocatalyst were added to the solution and stirred in darkness until the photocatalysts reached a state of suspension in the solution.
- The samples were then placed under a 450 W metal-halide solar simulator (with an intensity of 2.04 kW/m2), while being magnetically stirred. Samples were taken at 0, 0.5, 1, 1.5, 2, 5, 10, and 15 minutes for the duration of the test. The concentration and efficiency were determined using the Beer-Lambert law (1) and (2) respectively:

$$(1)\ log_{10}(I_o/I) = \varepsilon lc$$
$$(2)\ n = (C_o - C)/C_o * 100\%$$

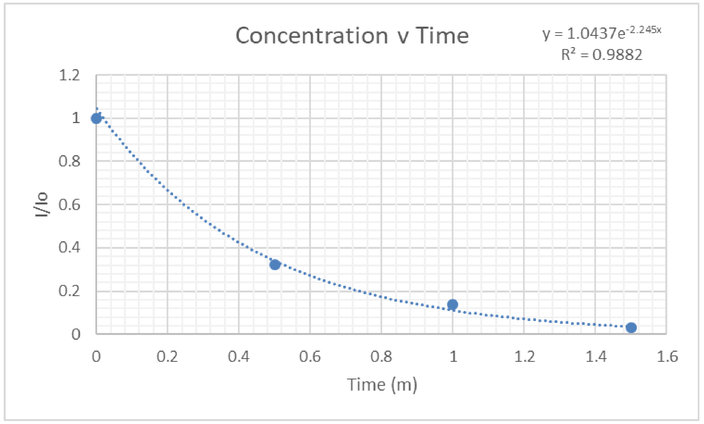
- ε is equal to the molar absorptivity value of MB (95000 dm3/[mole*cm]), I_o is the intensity of the light passing through the reference cell, I is the intensity of the light passing through the sample cell, and c is the concentration of the solution. The data is the absorbance values, degradation amount, and efficiency to assess the photocatalytic ability of the material.
- The data is being analyzed via graphs with given time intervals and the current concentration of pollutant with respect to the initial amount.

Results:





Charts & Diagrams:



Discussion:

- SEM imaging of Bi_2MoO_6 (1) indicates that the introduction of PVP did alter the morphology to form shard-like structures.
- SEM imaging of Ag_3PO_4 (2) depicts the correct morphology of simple cubes. Bi_2MoO_6/Ag_3PO_4 was successfully synthesized with a relatively uniform distribution of Bi_2MoO_6 within the Ag_3PO_4, and a junction was formed as evidenced in (3).
- XRD analysis (4) confirms not only the presence of both materials, but also the proper ratio as discussed in previous literature.
- Testing is ongoing; however preliminary tests of Bi2MoO6/Ag3PO4 have proven to agree with previous literature, lending further credibility to the proposed hypothesis.

Conclusions & Future Research:

- Photocatalysts maintain the potential to be a world-altering technology in applications ranging from deep space exploration to combatting climate change, using just the light emitted from the sun.
- One of the most efficient photocatalysts for water treatment applications has proven to be a Bi2MoO6/Ag3PO4 z-scheme. These two materials possessed ideal characteristics to be paired together due to their relatively small bandgap energies, as well as their compatible valance and conduction bands.
- To investigate whether their performance could be further improved upon, the morphology of the z-scheme was altered via the introduction of PVP to create a nanoflower-like geometry.
- Preliminary studies have demonstrated notable potential for the proposed z-scheme.
- Future studies will aim to assess the impact of the nanoflower morphology on the photocatalytic performance of Bi2MoO6/Ag3PO4 as well as accurately characterizing the properties of the material. Moreover future studies will investigate varying amounts of PVP in the formation of a nanoflower-like morphology, and the photocatalytic performance of Bi2MoO6/Ag3PO4 under natural sunlight.

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Selected References:

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[2] Dai, W., Yu, J., Xu, H., Hu, X., Luo, X., Yang, L., & Tu, X. (2016). Synthesis of hierarchical flower-like Bi2MoO6 microspheres as efficient photocatalyst for photoreduction of CO2 into solar fuels under visible light. CrystEngComm, 18(19), 3472–3480. https://doi.org/10.1039/C6CE00248J

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