Spring 4-13-2020

Titania-based Metal Photo-catalysts for Organophosphate Neutralization

Katelyn Alley
Montana Technological University

Quinn Cunneen
Montana Technological University

Dario Prieto
Montana Technological University

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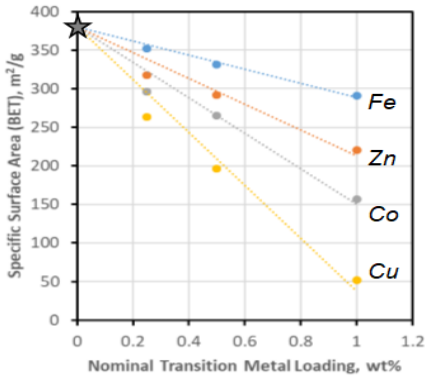
Katelyn Alley (BS Chem '21), Quinn Cunneen (BS Chem '20) and Dario Prieto

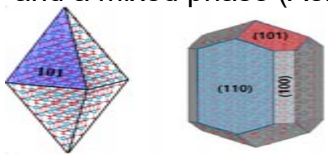
Background & Significance

- Organophosphates (OP) inhibit the breakdown of neurotransmitters and are extremely toxic
- Silica-supported metal catalysts can neutralize OP in presence of H_2O_2
- H_2O_2 is hazardous to transport, unsustainable to produce
- Silica decomposes during synthesis



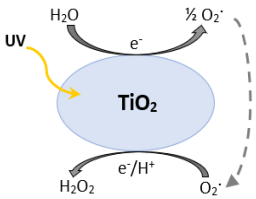
Potential solution: Titania

- Robust porous oxide with high SSA
- Two crystal phases (Rutile, Anatase) and a mixed phase (Aeroxide)



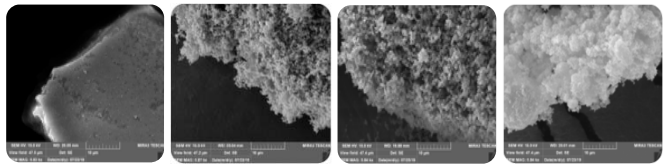
From:
Illas et al.
J. Phys. Chem. Lett.
2017, 8, 22, 5593

- H_2O_2 production under a UV irradiation



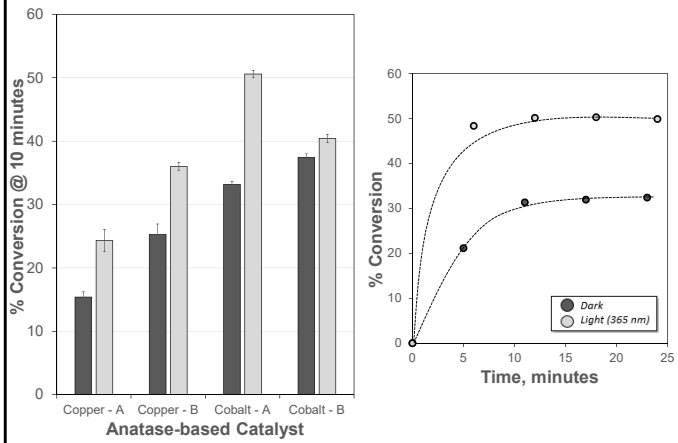
Adapted from:
Catal. Sci. Technol.
Royal society of chem,
7 (2017), 4977-4983

Higher metal loadings with Titania



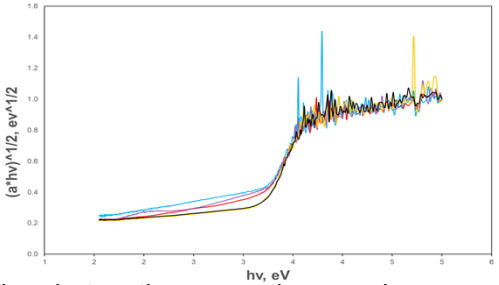
Silica	Anatase	Rutile	Aeroxide
Incipient Wetness, ml/g			
0.7	0.4	0.4	***0.8***
Surface Area, m^2/g			
370	50	50	65
Metal loadings, atom/nm^2			
0.00076	0.0032	0.0032	***0.0049***

UV light increases the rate of reaction



- Reaction can occur without UV light but the addition of UV light increases the reaction rate
- Materials prepared with EDTA and Nitrate show same reactivity
- Addition of titania to silica-based catalysts increases the reactivity

Metal loading affects activity



- The photoactive properties remain constant regardless of the material
- Activity change is due to the metal

Conclusion

- The materials are active in organophosphate neutralization without an oxidant
- No obvious changes in the band gap
- Light increases reaction
- The catalysts deactivate

Upcoming work

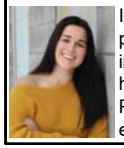
- Extend method to Fe, Co, and Zn
- Effect of metal precursor and loading on surface area and metal structure

Acknowledgments

This research was sponsored by the Combat Capabilities Development Command, Army Research Laboratory and was accomplished under Cooperative Agreement Number W911NF-15-2-0020.

We thank Gary Wyss, Molly Brockway, and Katie Hailer for their technical support.

Katelyn Alley Biochemistry 21'



I am currently a junior at Montana Technological University pursuing my degree in Biochemistry. I was born and raised in Butte, Montana and decided to pursue my degree at my hometown college. After graduation, I plan on pursuing a Ph.D. in chemistry. In the future, I would like to work as an educator to inspire the next generation of scientists.