Synthesis and characterization of novel rare-earth manganese oxide minerals for catalytic degradation of volatile organic compounds (VOCs)

Brittany A. Cymes, M.S.
Ph.D. Candidate, Miami University, Oxford, OH

Our industrialized world would be inconceivable without catalysts. A catalyst is a chemical compound that improves the general rate of a chemical reaction while not being consumed itself. Approximately 95% of all products produced worldwide involve some kind of catalyst during their manufacturing lifecycle. Naturally occurring and synthetic minerals such as noble metals, transition metal oxides, and nanoporous silicates are routinely used in catalysis. The mineral cryptomelane ($K(Mn^{2+} Mn^{4+})_8 O_{16}$) is an attractive catalyst material owing to its high surface area, mesoporosity, hydrophobicity, high oxygen mobility, and storage capacity but more importantly its low-cost, ease of synthesis, and ability to be altered with promoters in accordance with the needs to the desired reaction. In this investigation, cryptomelane has been synthesized by two different methods and promoted with europium, a well-known lanthanide used for modification in other catalytic systems. The effects of europium on the physical, chemical and catalytic properties of cryptomelane have been evaluated for an improved understanding of mineral crystallization kinetics and as proof of concept for a novel catalyst.

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