



Novel Catalysts for Improved Remediation of Sulfur-Containing Pollutants

WiSys: T190005W001

Inventors: Robert McGaff

WiSys Technology Foundation is currently seeking a strategic partner interested in providing a route to market for the commercialization and wide dissemination of its novel catalyst systems for sulfur remediation.

Overview

According to BCC research, the global catalyst market was valued at \$6.8 billion in 2015. With a CAGR of 2.8%, this market is anticipated to exceed \$8.0 billion by 2021. Driving this growth is the global demand for refinery catalysts (including hydrodesulfurization (HDS) catalysts for petroleum refining), a sector expected to reach 2,234.3 metric kilotons within the same period. While HDS is the industrial standard for the removal of sulfur from fuels, it remains an imperfect option due to its use of high temperature and pressure. In addition, this process is not effective for use in the removal of certain heterocyclic sulfur compounds such as dibenzothiophene (DBT) and related compounds. Oxidative desulfurization (ODS) has emerged as a promising alternative desulfurization technology due to its ability to operate at lower temperatures and pressures. However, existing oxidation methods can require use of undesirable organic solvents, expensive precious metals, toxic heavy metals, caustic strong bases and environmentally unfriendly oxidants. As such, there remains a need for development of green catalytic systems capable of efficiently operating under ambient conditions.

The Invention

A professor of chemistry at the University of Wisconsin-La Crosse has developed a versatile suite of iron-based catalysts with the potential to promote rapid, efficient oxidation of deleterious sulfur-containing compounds present in crude oil, natural gas, and/or aqueous waste streams. With these novel catalysts, there is no need for corrosive base, elevated temperatures, expensive or dangerous oxidants, or high pressures.

Applications

Mercaptan and hydrogen sulfide sweetening. Primary catalysts are capable of:

- Oxidizing a series of representative thiols and DBT in solution;
- Oxidizing vapor phase thiols demonstrating potential utility for removal of mercaptans from natural gas as well as gas-phase effluents from sources such as biodigesters and sewage treatment plants;
- Catalyzing oxidation of heterocyclic sulfur compounds present in non-polar hydrocarbons to sulfones thereby enabling effective removal via partitioning into a more polar phase;
- Oxidizing select thiols in model oil demonstrating ability to catalyze conversion of mercaptans dissolved in non-polar hydrocarbons to more easily separable disulfides.

Key Benefits

- Low cost and green - primary catalysts are based upon inexpensive, earth abundant and environmentally friendly iron;

- Select catalyst have been successfully immobilized on solid support providing for easier recovery;

- Reactions can be conducted at ambient temperatures and pressures without the need for elevated temperatures or caustic base.

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Stage of Development

Primary catalysts have been shown to successfully catalyze the oxidation of a series of substrates consisting of representative thiols (e.g. 2-mercaptoethanol, ethyl mercaptan and n-propyl mercaptan) and DBT. Substrates initially present in both solution (including in "model oil") and the gas phase have been successfully oxidized. Reactions have been carried out at room temperature and in many cases using only molecular oxygen from ambient air as the primary oxidant. Reaction times for 100% conversion range from as little as 40 minutes to seven hours with TON ranging from 700-4500.

Tech Fields

- [Clean Technology : Monitoring, remediation & waste reduction](#)
- [Materials & Chemicals : Biochemicals & biomaterials](#)

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