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ABSTRACT

PHOTOCATALYTIC OXIDATION OF ODOROUS COMPOUNDS USING ZR-BASED MOF@TIO2 CORE-SHELL STRUCTURED PARTICLES

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Summary
With the rapid development of large-scale livestock industry, malodorous gas discharged from livestock is in recent years attracting increased attention, and become an important factor restricting the sustainable development of livestock and poultry breeding. Emissions of odorous compounds can cause health symptoms on people in nearby areas, as well as affecting their quality of life. Given the burden of odor emissions on animals and the public health, odor control is quite essential.
Photocatalytic technology, as an advanced oxidation process, is considered to be a promising method for removing odor from livestock and poultry farms. However, the currently widely used TiO2 photocatalyst has low light utilization efficiency and poor adsorption performance for pollutants, resulting in unsatisfactory degradation efficiency, which restricts the application of this technology. Metal-organic framework materials (MOFs) with semiconductor properties, large specific surface area, and simple synthesis methods have attracted increasing attention. They have shown excellent performance in gas adsorption and separation, photocatalytic hydrogen production, CO2 reduction and VOCs degradation. The huge specific surface of MOFs is conducive to the adsorption of intermediate products and is expected to achieve deep degradation of pollutants. Studies have shown that the combination of MOF and inorganic semiconductors can construct a charge transfer path, improve the utilization efficiency of electrons and holes, thereby improving photocatalytic performance.
In this paper, UiO-66 was prepared by hydrothermal method and coated with different amounts of TiO2 layer on its surface to prepare a series of core-shell structured UiO-66@TiO2 catalysts, and investigated its photocatalytic degradation performance on odor compounds. Experimental results show that its performance is better than a single UiO-66 or TiO2. The four repeated use experiments showed only slight inactivation, proving its stable photocatalytic performance. X-ray diffraction (XRD) and other characterization methods were used to investigate its physical and chemical properties,

and the improvement mechanism of UiO-66@TiO2 photocatalytic performance was explored based on the characterization results and photocatalytic activity data. The results show that thanks to the super large specific surface area of UiO-66, the prepared catalyst can effectively adsorb pollutants and intermediate products to achieve the purpose of deep mineralization. In addition, the TiO2 layer and UiO-66 form a heterojunction, which can effectively broaden the light absorption range and improve the utilization of photo generated electron-hole pairs. This research can provide reference for the design of core-shell structured TiO2@MOF and photocatalytic purification of odor gas from livestock.

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