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Review

Ag/CeO_2 Composites for Catalytic Abatement of CO, Soot and VOCs

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Abstract: Nowadays catalytic technologies are widely used to purify indoor and outdoor air from harmful compounds. Recently, Ag–CeO_2 composites have found various applications in catalysis due to distinctive physical-chemical properties and relatively low costs as compared to those based on other noble metals. Currently, metal–support interaction is considered the key factor that determines high catalytic performance of silver–ceria composites. Despite thorough investigations, several questions remain debating. Among such issues, there are (1) morphology and size effects of both Ag and CeO_2 particles, including their defective structure, (2) chemical and charge state of silver, (3) charge transfer between silver and ceria, (4) role of oxygen vacancies, (5) reducibility of support and the catalyst on the basis thereof. In this review, we consider recent advances and trends on the role of silver–ceria interactions in catalytic performance of Ag/CeO_2 composites in low-temperature CO oxidation, soot oxidation, and volatile organic compounds (VOCs) abatement. Promising photo- and electrocatalytic applications of Ag/CeO_2 composites are also discussed.

Keywords: silver–ceria; metal–support interaction; CO oxidation; soot oxidation; VOCs abatement

1. Introduction

Air pollution is a major environmental problem. According to the World health organization, ambient air pollution contributes to 6.7 percent of all deaths worldwide [1], and the emissions of harmful compounds from industrial plants and motor vehicles in crowded urban areas are getting more attention. By reducing the level of air pollution, countries can reduce the morbidity rates of heart disease, lung cancer, chronic and acute respiratory diseases, etc. Many substances cause air pollution, including carbon monoxide (CO), particulate matter, ozone, nitrogen dioxide, soot, sulfur dioxide, organic dyes, etc., with CO being the most common among these pollutants. Volatile organic compounds (VOCs) comprising organic compounds with an initial boiling point inferior or equal to 250 °C (measured at a standard pressure of 101.3 kPa) also impact pollution of indoor and outdoor air [2]. In a recent review [3], the authors consider several main classes of VOCs, including halogenated VOCs, aldehydes, aromatic compounds, alcohols, ketones, polycyclic aromatic hydrocarbons, etc.

Therefore, air cleaning is a pivotal challenge, and new solutions are required. Catalytic total oxidation of organic pollutants into CO_2 and water is the most effective way to address this challenge. Metal/ceria-based catalysts were found promising heterogeneous catalysts for CO, soot and VOCs oxidation, and the highly dispersed noble metals (Me = Au, Pt, Pd, Ru, etc.) were used as the active components of these catalysts. The ceria-supported catalysts containing Pd [4–11], Pt [12–16],