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Research Article

Characterization and Catalytic Properties of Nano-Sized Au Metal Catalyst on Titanium Containing High Mesoporous Silica (Ti-HMS) Synthesized by Photo-Assisted Deposition and Impregnation Methods

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The photo-assisted deposition (PAD) and impregnation (img) synthesis of nano-sized Au metal on Ti-HMS are reported. The prepared catalysts were characterized by different techniques such as XRD, XAFS, TEM and nitrogen adsorption analysis. Photocatalytic reactivity using Au/Ti-HMS catalysts under visible-light condition on the oxidation of CO with O_2 reaction was evaluated. The results have shown notable photocatalytic activity of PAD-Au/Ti-HMS which was 2.1 and 5.7 times higher than that of img-Au/Ti-HMS and Ti-HMS, respectively.

1. Introduction

Titanium dioxide (TiO_2) is one of the most intensively studied heterogeneous photocatalysis for the photodEgradation of toxic organic pollutants because it is nontoxic, relatively cheap, chemically stable within a wide pH range, and robust under UV light irradiation [1–7].

Recently, the photodEgradation of some organic dyes using TiO_2 under visible light irradiation has been reported. The studies were significant due to both fundamental and practical aspects exploiting unique mechanisms and perspectives rEgarding treatment of dye pollutants under sunlight. However, the application of TiO_2 in photocatalytic reactions has been impeded as a result of the following obstacles. TiO_2 photocatalysis can only absorb UV light due to their band structure, UV light component in sunlight is a relatively small part (ca. 3–5%) of the solar spectrum, and artificial UV light sources are expensive. Moreover, although fine TiO_2 powders with large specific surface area exhibit high photocatalytic activity, an important issue rEgarding their recovery from aqueous suspensions has been taken into consideration [5–9].

In the last few years, it has been pointed out that there is a strong interest in catalysis by gold due to the potential of highly dispersed gold on various supports to exhibit high catalytic activities for a number of reactions, including CO oxidation [10]; alcohol oxidation [11]; olefin epoxidation [12]; selective hydrogenation of unsaturated hydrocarbons, and so forth, In the past decade, supported gold particles have been applied to catalyze many different types of reactions. The literature reflects a consensus that the preparation method and choice of support significantly influence the size and activity of supported gold. Mesoporous silica, which possesses large pore size and high specific surface area, shows excellent performance for the conversion of bulky reactants and has been considered as notable support for gold loading.

Various materials have been examined for supporting nano-gold. Of these, TiO_2 is extremely active, and on this compound, nano-gold can catalyze CO oxidation at very low temperatures and can catalyze the preferential oxidation