Accepted Manuscript

Effective removal of automobile exhausts over flower-like $Ce_{1-x}Cu_xO_2$ nanocatalysts exposed active {100} plane

A. Selvamani, K. Shanthi, D. Santhanaraj, C.M. Babu, V.V. Srinivasan, P. Thirukumaran, V. Ramkumar, A. Shakilaparveen, R. Balasubramanian

PII: S1002-0721(18)30110-8

DOI: 10.1016/j.jre.2017.12.006

Reference: JRE 129

To appear in: *Journal of Rare Earths*

Received Date: 21 August 2017

Revised Date: 6 December 2017

Accepted Date: 11 December 2017

Please cite this article as: Selvamani A, Shanthi K, Santhanaraj D, Babu CM, Srinivasan VV, Thirukumaran P, Ramkumar V, Shakilaparveen A, Balasubramanian R, Effective removal of automobile exhausts over flower-like $Ce_{1-x}Cu_xO_2$ nanocatalysts exposed active {100} plane, *Journal of Rare Earths* (2018), doi: 10.1016/j.jre.2017.12.006.

Effective removal of automobile exhausts over flower-like $Ce_{1-x}Cu_xO_2$ nanocatalysts exposed active {100} plane

A. Selvamani[a]*, K. Shanthi[a]*, D. Santhanaraj[b], C.M. Babu[c], V.V. Srinivasan[a], P. Thirukumaran[d], V. Ramkumar[a] A. Shakilaparveen[d], R. Balasubramanian[a]

[a]*Department of Chemistry, Anna University, Chennai 600 025, India*
[b]*Department of Chemistry,Lloyola College, Chennai 600 034, India*
[c]*Department of Chemistry, KU Leuven, Belgium*
[d]*Department of Chemical Engineering, Yeungnam University, South Korea*

This work elucidates the synthesis and characterization of copper ions incorporated ceria ($Ce_{1-x}Cu_xO_2$) nanocatalysts with 3D flower-like and nanocrystalline morphology for the purification of automobile exhausts. XRD and Raman results confirm the presence of copper ions in ceria. The 3D flower-like and nanocrystalline morphology exhibited by these catalysts were seen by FESEM images. HRTEM and SAED results confirm that (100) plane is dominantly presented in 3D flower-like $Ce_{1-x}Cu_xO_2$ catalysts when compared to nanocrystalline morphology. The textural properties of synthesized catalysts was done with the help of N_2 sorption study, which confirms that flower-like $Ce_{1-x}Cu_xO_2$ catalysts show high surface area and pore volume. The existence of Ce^{3+}, Ce^{4+}, Cu^{+} and Cu^{2+} ions in the catalyst were examined by XPS and DR UV-Vis techniques. Oxygen storage capacity (OSC) of the catalysts was studied by H_2-TPR analysis. These characterization results elucidate the presence of dominant active sites (Ce^{3+}, Ce^{4+}, Cu^{+} and Cu^{2+}) and {100} plane in the flower-like morphology compared to nanocrystalline. The catalytic activity of synthesized $Ce_{1-x}Cu_xO_2$ catalysts was tested for removal of CO, HC_x and NO gases from automobile emission with respect to the copper content and morphology. The obtained results indicate that the presence of optimum amount of copper in ceria with flower-like morphology is essential for the removal of CO, HC_x and NO at low temperature *via* redox process, which is due to the presence of active sites on the dominant {100} plane.

Keywords: Automobile exhausts; Flower-like Ceria; Morphology; Rare earhts

Corresponding authors: A. Selvamani, K. Shanthi (**E-mail**: selvamani.ana@gmail.com, kshanthiramesh@yahoo.com **Tel**.: +91-44-22358664)

1. Introduction

In the past decades the main focus of the researchers was to reduce the emission of industry, power plants and the transport sectors [1]. In particular, incomplete combustion that occurs in gasoline engine leads to massive emission of carbon monoxide (CO), hydrocarbons (HC_x) and nitrogen oxides (NO) in the atmosphere [2,3]. These hazardous oxides are most responsible for atmospheric pollution and climate changes [4]. Also, the emission of diesel particulates can be easily inhaled by human and leads to lung problem due to its small size around 2 µm, so called "lung-damaging dust" family [5].

Three-way catalysts (TWCs) have been extensively used for gasoline fueled vehicle to reduce the level of CO, HC_x and NO [6]. The components of TWCs usually include Rh, Pt