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Green synthesis of ceria powders with special physical properties by carbon dioxide carbonization

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Abstract

In order to improve the application values of Ce element, in this paper, rare earth chloride solution was used as raw material, the pH value was controlled by inorganic alkali, the ceria powders with special physical properties were prepared by carbon dioxide carbonization method. $Ce(OH)_3$ prepared at pH=7.5 exhibits smaller particle size than that prepared at other conditions. CeO_2 precursor obtained by direct carbonization of $Ce(OH)_3$ shows smaller particle size and narrow size distribution. According to characterization of SEM, XRD, and TG-DSC, CeO_2 precursor forms at first by carbonization of $Ce(OH)_3$ with the continuous addition of CO_2 gas, and the chemical component is indicated to be $Ce_2O(CO_3)_2 \cdot 6H_2O$. Cubic phase CeO_2 powders are obtained by calcined at 750 ^oC for 4 h. The mean particle size D_{50} is 0.941 μm, and particle size distribution is smaller than 1. The microscopic appearance is homogeneous, with a spherical-like shape and a grain size of 200–500 nm. The light quality characteristics of sedimentation volume and accumulation density are obviously better than those of carbonate precipitation products. The carbonization method can be used not only to obtain ultra-fine rare earth oxides with fine particle size, narrow distribution and high dispersion properties, but also to achieve the reuse of carbon dioxide greenhouse gas.

Keywords: Carbon dioxide; Carbonization method; Ceria; Green; Special physical properties; Rare earths

1. Introduction

Rare earth oxides are key raw materials for preparing rare earth luminescent materials, crystal materials, ceramic materials, catalytic materials and other high-tech materials. With the development of rare earth application fields, the requirement to quality of the rare earth oxides has been changed from the pure chemical composition and purity to crystal type, particle size, morphology, and other physical properties [1-5].

Rare earth oxides are mainly from the three major rare earth resources in China, i.e., Baotou mixed rare earth ore, Sichuan fluorocarbon cerium ore and southern

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