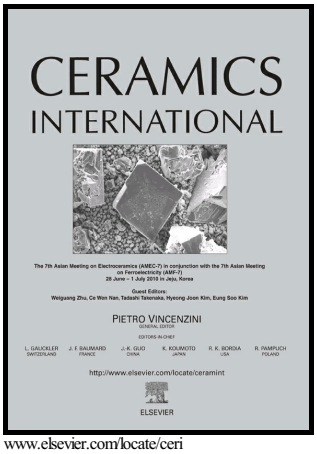

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Effect of fuel type on the microstructure and magnetic properties of solution combusted Fe_3O_4 powders

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Abstract

Porous magnetite (Fe_3O_4) powders were synthesized by solution combustion method using the glycine and urea at different fuel to oxidant ratios (ϕ). The combustion behavior depended on the fuel type as characterized by thermal analysis. The structure and phase evolution investigated by X-ray diffraction method showed nearly single phase Fe_3O_4 powders which were achieved only by using the glycine fuel at ϕ=1. The specific surface area and porous structures of the as-combusted Fe_3O_4 powders were characterized by N_2 adsorption-desorption isotherms and scanning electron microscopy, respectively. The surface area using the glycine fuel (62.6 m^2/g) was higher than that of urea fuel (42.5 m^2/g), due to different combustion reactions. Magnetic properties of the as-combusted powders were studied by vibration sample magnetometry which exhibited the highest saturation magnetization of 74 emu/g using the glycine fuel at ϕ=1 on account of its high purity and large crystallite size.

Keywords: Fe_3O_4; Solution combustion synthesis; Fuel; Magnetic properties

1. Introduction

In recent years, mesoporous transition metal oxides have attracted much attention in electrochemistry, catalysis, solar cells, sensors, capacitors, etc., not only due to the large surface areas and uniform and tunable pore sizes, but also for their unusual electrical, magnetic and optical properties [1–3]. Mesoporous materials are usually synthesized using soft templates such as alkyl amine or hard templates like mesoporous silica and carbon which limit the applications of the methods, due to the multistep procedures of template dissolution after synthesis [4, 5].

Magnetite (Fe_3O_4), as a cubic iron oxide with inverse spinel structure, has been widely used in a variety of technological applications, such as magnetic recording media, catalyst, energy storage,