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Effect of Reaction Factors on the Fabrication of Indium Oxide Powder by Spray Pyrolysis Process

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1. Introduction

Spray pyrolysis process to produce the high functional nano-sized oxide powder makes it possible to: 1) omit the essential processes, such as mixing, calcinations and milling of solid powder, requested by the dry method; 2) control the properties of the generated powder by varying the conditions of the pyrolysis reaction; and 3) lower the possibility of mixing with impurities. Since it is much easier to remove the impurities in solution state than in solid state, spray pyrolysis process is considered as a satisfactory method for manufacturing nano-sized oxide powder.

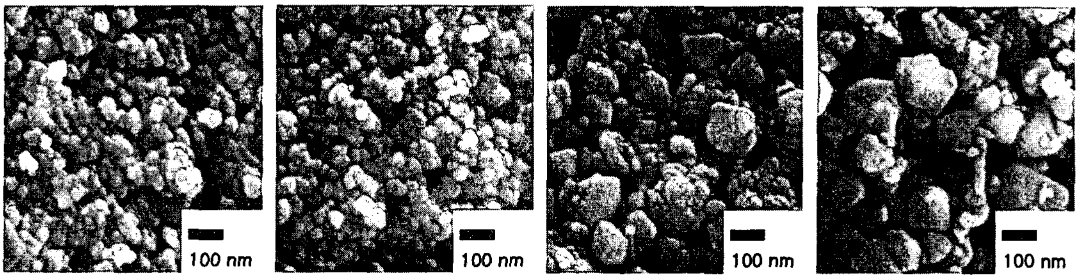
In this study, nano-sized indium oxide powder with the average particle size below 100 nm is fabricated from the indium chloride solution by the spray pyrolysis process. The effects of the reaction temperature, the concentration of raw material solution and the inlet speed of solution on the properties of powder were studied.

2. Experimental Procedures

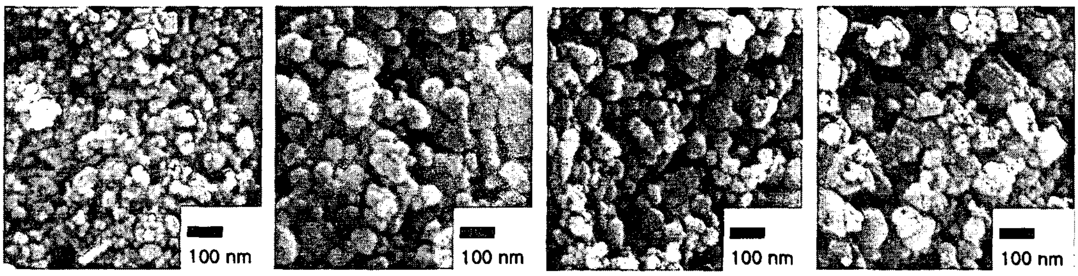
In this study, the indium chloride solution was utilized as the raw material of spray pyrolysis process. The concentration of indium in this solution was 350 g/l. And this solution was diluted by distilled water so that the indium concentration in the solution is adjusted to 200, 100 and 40g/l. An efficient spray pyrolysis system, which includes atomization device, pyrolysis reaction furnace, powder collection device such as bag filler and the scrubber device disposing hazardous gas products, is specially designed for this study. By adjusting the reaction temperature, the concentration of raw material solution and the inlet speed of solution, the properties of the correspondingly generated powder were investigated by SEM analysis(particle size distribution, average particle size and particle shape), XRD analysis (phase and composition of the powder) and measurement of surface area.

3. Results and Discussion

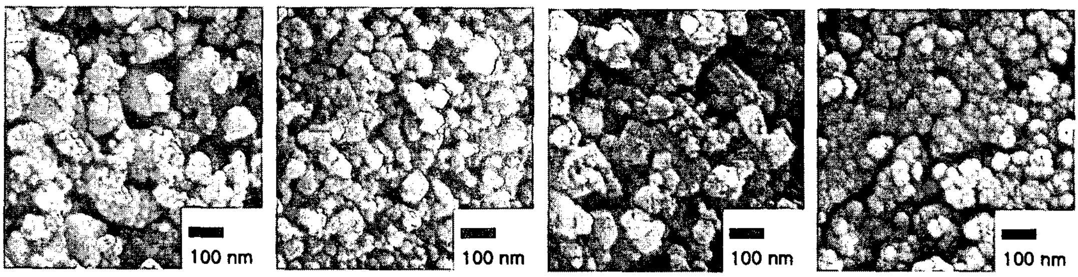
As the reaction temperature increased from 850 to 1000°C, the average particle size of produced powder increased from 30 to 100 nm, and microstructure becme more solid, the particle size distribution was more irregular, the intensity of a XRD peak increased and specific surface area decreased. As the indium concentration of the raw material solution increased from 40 to 350 g/ℓ, the average particle size of the powder gradually increased from 20 to 60 nm, yet the particle size distribution appeared more irregular, the intensity of a XRD peak increased and specific surface area decreased. As the inlet speed of solution increased from 2 to 5 cc/min., the average particle size of the powder decreased and the particle size distribution became narrower. In case of the inlet speed of 10 cc/min, the average particle size was larger and the particle size distribution was much irregular compared with the inlet speed of 5 cc/min. As the inlet speed of solution was 50 cc/min, the average particle size was smaller and microstructure of the powder was less solid compared with the inlet speed of 10 cc/min. The intensity of an XRD peak and the variation of specific area of the powder had the same tendency with the variation of the average particle size.



(a) 850℃ (b) 900℃ (c) 950℃ (d) 1000℃



(a) 40 g/l (b) 100 g/l (c) 200 g/l (d) 350 g/l



(a) 2 cc/min. (b) 5 cc/min. (c) 10 cc/min. (d) 50 cc/min.