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Fabrication of Nano-Sized Complex Oxide Powder by Spray Pyrolysis Process

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ABSTRACT

Nano-sized Ni-ferrite powder was fabricated through spray pyrolysis process in order to efficiently recycle the waste solution resulting from shadow mask processing,. The average particle size of the produced powder was below 100nm. In this study, the effects of reaction temperature, the injection speed of solution and the concentration of raw material solution on the properties of fabricated powder were investigated.

As the reaction temperature increased from 800°C to 1100°C, average particle size of the powder significantly increased and powder structure became more solid, whereas its specific surface area was greatly reduced. The average particle size was below 50nm when reaction temperature was below 900°C, was about 50nm at 1000°C, and increased up to 70nm at 1100°C. Phases of $NiFe_2O_4$, Fe_2O_3 and NiO coexisted at all reaction temperatures. Formation rate of the $NiFe_2O_4$ phase increased along with the temperature rise.

As the concentrations of iron and nickel components in waste solution increased, the average particle size of the powder became larger, particle size distribution became more irregular, and specific surface area was reduced. When the concentration of iron in solution was 40 g/ℓ, average particle size was about 30nm and particle size distribution was fairly homogeneous. As the concentration of iron increased from 70g/ℓ to 200g/ℓ, the average particle size increased up to 50nm and particle size distribution became more irregular due to the disruption of droplet during spray pyrolysis process. Regardless of solution concentration, phases of $NiFe_2O_4$, Fe_2O_3 and NiO coexisted. Formation rate of the $NiFe_2O_4$ phase significantly increased along with the increase of the concentration of solution.

As the inlet speed of solution increased, average particle size of the powder became larger, particle size distribution became wider, specific surface area decreased and powder structure became less solid. When the inlet speed of solution was 2 cc/min., average particle size was around 30 nm and particle size distribution was relatively narrow. As the inlet speed of solution increased to 10 cc/min. and 50 cc/min., average particle size increased up to 70 nm, and particle size distribution became wider. Especially, when inlet speed is 150 cc/min., the powder structure was extremely irregular and not solid, and particle size distribution became significantly wider. As the inlet speed of solution decreased, formation rate of the $NiFe_2O_4$ phase significantly increased.