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Synthesis of Cobalt Boride Nano Material in Triple DC Thermal Plasma Jet System

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The cobalt-based nanoparticles have recently drawn considerable research attention due to its promising technological application such as information storage, magnetic fluids and catalysts for hydrogen storage and fuel cell applications. Among them, cobalt boride is used in the manufacture of magnetic, wear resistant and high strength alloys. It is predict that the magnetic property of cobalt boride nanoparticles is possible to apply for sensor device [1-3].

The cobalt boride nanoparticles were synthesized by triple Direct Current (DC) thermal plasma jet system. This system was developed for the improved vaporization of refractory material. In the general singular thermal plasma jet system, injection of raw material into the high temperature region of thermal plasma jet is difficult due to the high viscosity of plasma jet core. Therefore, although thermal plasma jet could generate high thermal environment above 10,000 K, the vaporization of refractory material was incomplete. In our system, on the other hand, the triple thermal plasma jets generated from the three torches are encountered at the center axis of the reactor. The injected starting material from the top of thermal plasma jet system goes through the wider high temperature region for a longer residence time compared with singular torch system. Figure 1 shows the schematic diagram of the triple DC thermal plasma jet system for synthesis of cobalt boride nanoparticles.

In this work, cobalt boride (CoB and Co_2B) nanoparticles were synthesized from micro-sized cobalt and amorphous boron powder. The characteristics of thermal plasma jet were controlled by plasma forming gas; Argon with high thermal conductive gas as N_2, and H_2. The total flow rate of the discharging gas was fixed at the 28 L/min. The starting materials were injected into the plasma flame with the carrier gas through the injection tube between three torches, then feeding rate was 300 ~ 500 mg/min with argon carrier gas of 5 L/min. The cobalt and boron were mixed at 1 to 3 molar ratio to provide the sufficient boron vapor. Total input power was controlled at 20 to 30 kW according to the plasma forming gas. The synthesized product was collected in separated reactor from R-1 to R-6 and the filter.

As results, cobalt boride nanoparticles were synthesized at tens of nanometer and then, characteristic of synthesized powder was analyzed according to various experiment condition. The synthesize powder were analyzed for their characteristics by X-ray diffraction (XRD) and scanning electron microscope (SEM).

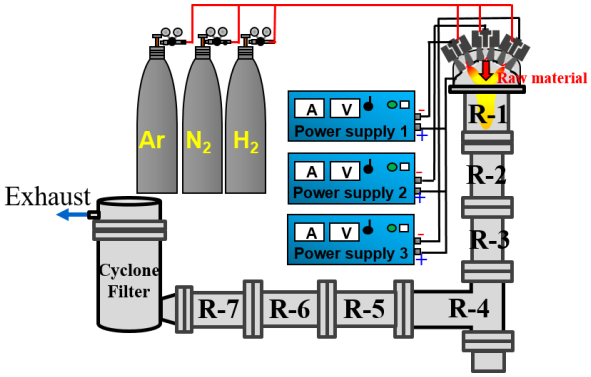

Figure 1. Schematic diagram of the triple DC thermal plasma jet system for synthesis of cobalt boride nanoparticles.

References

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