Study on extrusion process of SiC ceramic matrix

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Abstract. In this thesis, the extrusion process of SiC ceramic matrix has been systematically studied. The effect of different cellulose content on the flexural strength and pore size distribution of SiC matrix was discussed. Results show that with the increase of cellulose content, the flexural strength decreased. The pore size distribution in the sample was 1um-4um, and the 1um-2um concentration was more concentrated. It is found that the cellulose content has little effect on the pore size distribution. When the cellulose content is 7%, the flexural strength of the sample is 40.9Mpa. At this time, the mechanical properties of the sample are the strongest.

1. Introduction
The porous silicon carbide ceramics have a large surface area, hydrophilic, excellent performance, high temperature, resistance to acid corrosion, light, etc., it is widely used in various fields catalyst industry, metallurgical industry, sewage treatment, car exhaust emissions treatment[1]. Now the market is mainly recrystallization[2-4] method of preparing porous silicon carbide ceramic, but its complex manufacturing process, high production cost, is not conducive to a wide range of application porous ceramic silicon carbide. Mullite and silicon carbide has good chemical compatibility, similar chemical creep resistance, can be better at a low temperature silicon carbide are bonded together using mullite bonded silicon carbide, silicon carbide porous ceramic preparation can be achieved low-temperature sintering. Therefore, this paper uses mullite bonded silicon carbide[5] to prepare silicon carbide porous ceramic. not only greatly reduce the cost but also have relatively simple preparation process.

2. Experimental part
2.1. Experimental material

| Experimental material name               | Experimental equipment          |
|------------------------------------------|--------------------------------|
| silicon carbide                          | ball mill tank                 |
| silica fume                              | agitator                       |
| alumina                                  | tube type resistance furnace   |
| polyethylene glycol                      | ceramic tube extrusion machine |
| glycerol                                 | muffle furnace                 |
| oleic acid                               | electric blower drying box     |
| hydroxypropyl methylcellulose            |                                |
2.2. Experimental method

(1) Mix Pour the weighing ingredients into the blender in turn, and stir in the mixture for a certain amount of time. Finally, add the aqueous solution of polyethylene glycol to a small amount of water, stirring for 20 minutes;

(2) Clay preparation The mixture was stirred in the ceramic tube extruding machine pugging three times, making all kinds of raw materials full contact, exclude mud inside air, avoid extrusion products within the air bubbles appear on the surface;

(3) Stale The stirred mixture contains a variety of ingredients that are confused and contain a lot of air, which causes pores on the surface of the product when it is extruded. Therefore, the mixture would be a good mix of practice mud wrap, stale 12h, so that the sample of hydroxypropyl methyl cellulose can better react with water, enhance the plasticity of paste viscosity is reduced, extrusion molding for samples;

(4) Squeeze Select the desired shape of the product mold, and then use the ceramic pipe extrusion machine extrusion products;

(5) Dry The extruded products first placed in the air naturally dry for 12h, and then placed in the oven at 100 °C temperature drying, the time is 2h;

(6) Burn Cut the dried good products into slices, smooth them, and place them in the resistance furnace and pre burning them to remove the organic plasticizer in the sample.

2.3. Experimental characterization

2.3.1. Flexural strength test. The bending strength can be called bending strength, that is, the maximum pressure occurs when the product is broken. The flexural strength of SiC ceramics is closely related to the distribution of bubbles inside the product, the complete mixing of the particles, porosity and pore size distribution. In this experiment, the bending strength of the products was measured by three point method. The products are firing ultrasonic cleaning to remove the product surface of carbon black, and then dried in an oven at a temperature of 100 °C for 2 hours. Finally, the flexural strength of the product is measured by a computer controlled insulation material testing machine. During the experiment, the length, width and thickness of the product were measured with a vernier caliper, and then the vertical pressure was applied to the middle part of the product until the product was broken, and the data were recorded.

2.3.2. Detection of pore size distribution. In this experiment, the pore size distribution of the test article was measured by the bubble point method, the test sample was placed in a solution with a large wetting angle so that the pores in the sample to be measured were filled with the infiltration solution. The diameter of the through-hole of the sample to be measured is calculated by measuring the size and flow rate of the gas flow rate of the sample to be measured (the test results characterize the flux of the through-hole, which is more meaningful than the mercury-mercury meter data), using the equipment for the POROMETER pore size distribution tester (Germany, Porolux Nv company).

3. Results and discussion

3.1. Influence of cellulose content on folding strength
As can be seen from Fig 1, with the increase of cellulose, the flexural strength of products will gradually decrease. When cellulose is 4%, the flexural strength of the product is highest, reaching 46 Mpa. When the cellulose was added to 5%, the flexural strength gradually decreased to 42.1 Mpa, and the amount of cellulose added to 6% continued, then the flexural strength continued to decrease and reached a minimum peak value of 38.9 Mpa. The 7% products in the fiber, the flexural strength increases suddenly due to the hydration reaction of cellulose and water more completely, the products of cellulose is not too much, leaving the pore is relatively small, so the flexural strength will suddenly increase. When cellulose was added to 8%, the flexural strength decreased and reached a minimum of 36.8 Mpa, when the product was easy to break. In the process of mixing, the cellulose added will volatilize in the pre-burning process, and the pore left after volatilization will reduce the flexural strength of the products and break easily. Therefore, the flexural strength will decrease with the increase of cellulose.

3.2. Effect of cellulose content on pore size distribution

As can be seen from Fig 2, the pore size distribution and volume distribution of samples with different fiber content, it can be seen from the figure, with the increase of cellulose content was smaller pore size distribution.
and gas flow distribution in the sample, the sample aperture roughly distributed between 1um-4um, and 1um-2um distribution is relatively concentrated. When the airflow passes through the sample, a less part of the air flow passes through 1um-2μm holes between , and the other air streams pass through larger holes between 2um-4um, although the pore size is mainly concentrated between 1um-2um, but the airflow is mainly from 2um-4um The hole is passed so that the air flow of the sample is mainly due to the large pore distribution of 1um-2um pores and the distribution of less than 2um-4um between the large pore contribution.

4. Conclusion
The addition of cellulose has a great impact on the performance of the product. With the increase of the amount of the cellulose, the porosity of the product gradually increases, the distribution of the pore size is gradually concentrated, the flexural strength decreases first and then increases trend. When the cellulose content is 7%, the flexural strength of the sample reaches 40.9Mpa, and the mechanical properties of the sample are the best.

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