Research on Bamboo Charcoal Bonded Grinding Wheel and Its Mechanical Properties

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Abstract. In this paper, a new type of grinding wheel and its manufacturing production process are introduced. The new BCB (Bamboo Charcoal Bond) grinding wheel was made of bamboo charcoal, phenolic resin and abrasive powder with higher press and temperature. To investigate its mechanical features, such as Rockwell hardness, resistance to abrasion, and resistance to pressure, some experiments on three BCB samples with different Resin weight ratios 20%, 25%, 30%, were carried out. The results showed that the BCB sample with proper moulding process and Resin weight ratio had better performance.

Keywords: BCB Grinding Wheel; Surface Clean Grinding; Mechanical Properties

NOMENCLATURE: BCB = Bamboo Charcoal Bond

1. Introduction

The development trend for new machining methods is that they should be more convenient, more precise and pollution-free for workpiece surface. For these new machining process demands, BCB (Bamboo Charcoal Bond) grinding wheel was developed. Bamboo charcoal has the characteristics of high density, porous structure, good wear resistance, higher conductivity, etc. [1]. For the ELID grinding process, the grinding wheel should have good conductivity property; the BCB diamond grinding wheel is made by bamboo charcoal mainly, therefore it has the good conductivity and higher strength for achieving the ultra-precision machining of new advanced materials such as silicon and sapphire wafers, even the non-hard metal materials.

2. Experimental set-up

The production process of BCB sample is shown in Fig. 1. The bamboo charcoal powder, phenolic resin and abrasive powder were mixed and put in the mould controlled by a temperature regulator. Then, the mould was set on a pressing machine. Fig. 2 shows the pressing system with mould surrounded by a heating tape.
3. Mechanical performance test

3.1 Rockwell hardness

A material’s hardness is a main mechanical property for keeping its higher machining efficiency. Six points on the workpiece surface were measured with XHR150 Rockwell tester to get the average Rockwell hardness. The average Rockwell hardness is presented in Fig. 5. The sample’s Rockwell hardness of the two sides were improved when the phenolic resin’s content was increased. Anyway, it was shown that the Rockwell hardness of the samples were higher when the weight ratios of phenolic resin was higher, because the higher content of phenolic can make a sample of higher strength.

3.2 Resistance to abrasion

Resistance to abrasion is very crucial for grinding wheel to have long service life. The performance of three BCB samples were tested and compared, as shown in Fig. 6. It is shown that the BCB sample c (30%) has better frictional wear resistance performance than sample b (25%), and sample a (20%); sample a (20%) has the highest lost weight, which means it has worse frictional wear resistance performance. The BCB sample with higher composition of phenolic resin (30%) has higher Rockwell hardness based on the results above in section 3.1; therefore, it has better performance in resistance to abrasion.
3.3 Resistance to pressure

The resistance to pressure is also one of grinding wheel’s necessary mechanical properties. The experimental data and results are shown in Fig. 7. In Fig. 7 (a), the non-carbonized sample with resin content of 30% can endure the pressure of almost 100 MPa, while the other one with that of 20% can only endure pressure of about 50 MPa. This is because the higher content of resin can make BCB sample harder than others when resin solidifies. In Fig. 7 (b), (c) and (d), it is shown that the carbonized samples’ resistance to pressure is much lower than those of the non-carbonized samples, which is because the structure of the resin in the sample was destroyed significantly during the carbonization process.

![Fig. 7(a) Resistance to pressure of non-carbonized samples](image1)
![Fig. 7(b) Resistance to pressure of samples carbonized at 500℃](image2)

![Fig. 7(c) Resistance to pressure of samples carbonized at 750℃](image3)
![Fig. 7(d) Resistance to pressure of samples carbonized at 900℃](image4)
4. Conclusions

Aiming to develop surface clean grinding technique, a new kind of BCB grinding wheel was proposed, and the manufacturing process and some of its basic mechanical properties were introduced and studied in this paper. Based on the results discussed above, the following conclusions were drawn.

(1) With different weight ratios of resin, the BCB sample with the higher ratio of resin has better resistance to abrasion than the one with low ratio of resin.

(2) Also, the BCB sample with the higher ratio of resin has higher Rockwell hardness, but the increasing trend become slow, and the upper side of BCB sample has better performance than the nether side.

(3) Resin content affects the BCB sample’s performance in resistance to pressure. The carbonized sample’s resistance to pressure is much lower than that of the non-carbonized sample. Moreover, higher carbonization temperature can make the BCB sample have higher bond strength.

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References

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