Development of rod-shaped grinding media for cryogenic mill Part 2: Grinding ability depending on grinding media materials

[Background] In the previous note (PYT-040E), wood (toothpicks) and superfiber (Vectran (F) #30) were ground using two types of grinding media: WC sphere and stainless steel (SS) rod. The results demonstrated that the rod-shaped grinding media exhibited superior grinding ability compared to the sphere and were found to be highly effective for grinding samples. In this note, toothpicks were selected and ground using four kinds of rod-shaped grinding media, each made of different materials as listed in Table 1. The resulting powders were classified, and the yields - defined as the mass ratio of fine powder to the total ground product - were determined. Furthermore, the relationship between the rotation speed and the yield at room temperature was examined. Based on these results, the grinding ability of the four rod-shaped media was compared.

[Operation] Two toothpicks (0.2 g) cut into a length of 5 mm and one of the four kinds of rod-shaped grinding media were placed in a sample container and ground at room temperature using a cryogenic mill (IQ MILL-2070, Frontier Labs). This was repeated with the remaining three rods. The ground powders were then classified using a 177 μm (80 mesh) sieve.

[Results] The yields of powders of 177 μm or less obtained by grinding the toothpicks followed by classification are shown in Fig. 1. The yield with the WC rod-shaped grinding media was about 1.2 times higher than that with the SS rod-shaped grinding media. The yield increased as the mass of the rod-shaped grinding media increased. Fig. 2 shows the yields obtained when grinding at rotation speeds of 1500, 2000, 2500, and 3000 rpm. The yield increased with increasing the rotation speed for all rod-shaped grinding media. The yield with the WC rod-shaped grinding media was the highest at all rotation speeds. In conclusion, it was demonstrated that the grinding ability of the four kinds of rod-shaped grinding media differs depending on their materials. By appropriately selecting the material of the rod-shaped grinding media, it is possible to grind a variety of samples, from coarse to fine.

Table 1 Material and mass of rod-shaped grinding media.

Product	Material	Length	Outer diameter	Mass (g each)	Appearance
SS grinding rod12	Tungsten carbide stainless steel (SUS)	20 mm	12 mm	16	
Ti grinding rod 12	Titanium (Ti)			9	
Zr grinding rod 12	Zirconia (ZrO_2)			12	
WC grinding rod 12	Tungsten carbide (WC)			28	

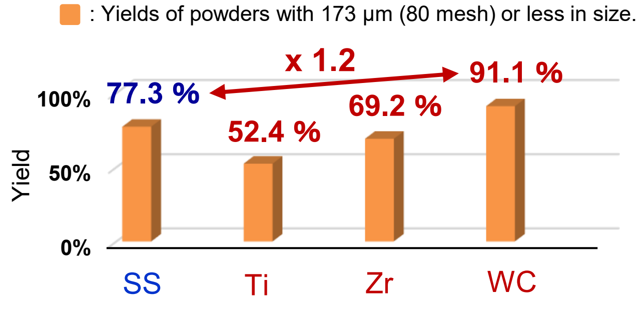

Fig. 1 Yield of powders with particle sizes of 173 μm or less obtained by grinding and classifying toothpicks (averaged value of n=3).

Grinding temp.: Room temp., Rotation: 3,000 rpm, Grinding time: 30 s, No. cycles: 1 cycle, Grinding media type: Rod-shaped grinding media.

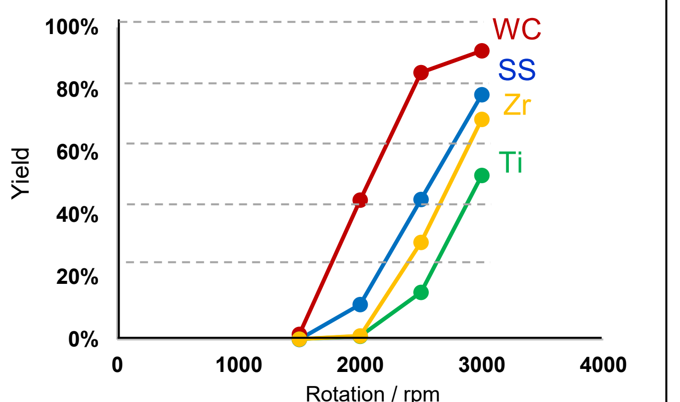

Fig. 2 Correlation between the rotation speed and the yield for four kinds of rod-shaped grinding media.

Keywords : Room temperature grinding, Rod-shaped grinding media, Micronization, Pulverization, ball

Products used : Cryogenic Mill, IQ Mill 2070, SS grinding rod 12, Ti grinding rod 12, Zr grinding rod 12, WC grinding rod 12

Applications : General polymer analysis

Related technical notes : PYT-039E, PYT-040E (Part 1)

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