別紙４（課程博士）

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Abstract

論文内容の要旨　(博士)

Title of Thesis 博士学位論文名	Influence of surface modification by blast polishing method on the cutting performance of carbide tool (超硬ツールの切削特性に及ぼすブラスト研磨法による表面改質の影響)

(Approx. 800 words)

(要旨　1,200 字程度)

Nowadays, the carbide cutting tools are widely used due to its excellent in heat and wear resistance and has the ability to withstand rigorous operating under high speeds conditions. Following the trend, the CNC grinding machine has advanced significantly which enables manufacturers to produce the cutting tool with more complex and sophisticated shapes easily. As a result, competition becomes intense in these field. Therefore, research on surface modification technology has gathered a lot of interest, which could ultimately improve machining performance from viewpoints other than tool geometry. Several research on the surface modification on the cutting tool surface had been conducted in order improves the cutting tool performance and durability. A lot of method had been researched and reported including surface modification by implanting a textures on the surface as well as by mirror polishing the tool surface.

The blast polishing process is one of surface modification technologies favorably applied to the carbide cutting tools due to its excellent ability to polish a complex curve surface of the cutting tool, which is known to be a difficult processing, and improve the surface property of materials effectively. However, the blast polishing process has a limited information that theoretically explains its polishing mechanism. The relationships between the polishing parameters to the polished surface properties were also unknown. Therefore, as the first part of this thesis, the investigation of the polishing mechanism of cemented carbide using the blast polishing process is conducted by clarifying the relationship of the factors related to this polishing and the polished surface condition. Moreover, fewer cases had been reported regarding the influence of the blast polishing process to the cutting tool performance when actually applied this process to the cutting tools surface. Therefore as the second part of this thesis, the influence of surface modification by the treatment using blast polishing process to the cutting performance of the cutting tool is investigated. For this purpose, the conditions of grinding mark textures on the cutting tool surface is controlled and modified by the treatment using blast polishing process. And, the cutting tool performance is access by evaluating the improvement of the adhesion resistance on the tool surface as well as the improvement of lubricant fluidity and chip evacuation by measuring the cutting force relation with the drilling time and drilling depth.

In the first part of this thesis, which is regarding the study of polishing mechanism of the blast polishing process, it has been clarified that a smooth surface finish can be achieved easily and quickly by injecting the polishing media at the highest injection speed of 59.5 m/s, under injection angle of 45 deg. with water content of 30%.

Regarding the study of optimal surface property for the drill by surface modification using blast polishing process, it was clear that a different surface conditions is required in each part of the cutting tool flute surface in order to maximize the potential of the cutting tool. The cutting tool performance is shown to increase by leaving grinding mark textures on the rake face and smoothest the guide flute surface. This is because each flute surface parts function differently due to different work environment during the cutting process. The part near the cutting edge of the flute surface, the rake face work environment is more severe because this surface come to direct contact with the work piece. The chip is generated in this area thus the adhesion formation likely to occur. Therefore, the texture on the rake surface helps to reduce the real contact area between the surface and the work piece by providing a reservoir for the lubricant to retain inside it during the sliding to reduce the friction at the interface. Thus, the adhesion resistance is increased.

Furthermore, for the guide flute surface which is the major part of the drill surface. It main work function is to allow the excess of lubricant inside the hole to reached the rake face and also to provide an exit path for the chip generated inside the hole to evacuate. Its work environment is not as critical as the rake face and the adhesion is less likely to occur on the surface. Therefore the condition of the guide flute must be smooth polished surface to reduce the friction on the surface and increase the fluidity of the lubricant. As a results, lower cutting force is obtained and delaying the rise of the cutting force during the drilling process.