Effect of WC grain size on microstructure and mechanical properties of WC-TiC-Co Cemented Carbides

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1. Introduction

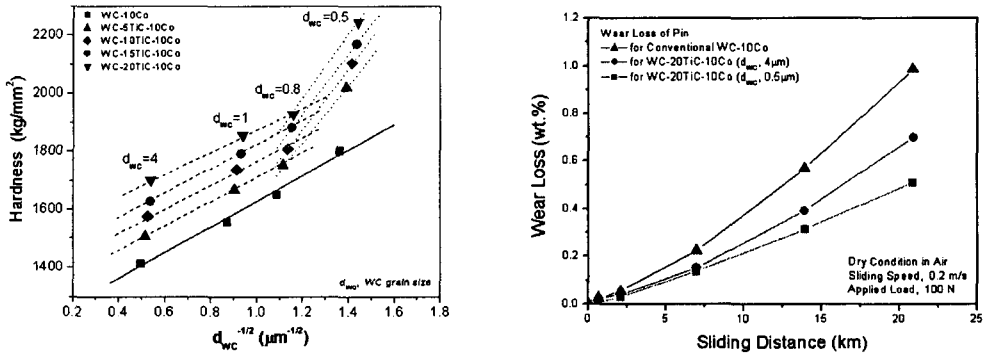
The addition of TiC in WC-Co cemented carbides enhances hardness and wear resistance, but degrades the fracture toughness of cemented carbides [1,2]. At the same time, Ultra-fine and nanocrystalline WC-Co cemented carbides were introduced with enhanced hardness and wear resistance [3]. However, the refinement of cemented carbides has not been applied to WC-TiC-Co cemented carbides, which is more widely used for cutting tools than WC-Co cemented carbides. In this study, the microstructure and mechanical properties of WC-TiC-Co cemented carbide according to WC grain size with various TiC contents at a given TiC particle size was investigated.

2. Experimental Procedure

The WC grain size of (90-x)WC-xTiC-10Co cemented carbides was controlled by controlling initial WC powder size from 0.57μm to 4.06μm with constant TiC particle size of 1μm. The TiC content is varied from 0 to 20wt.%. The green compacts were hot-isostatically pressed under a pressure of 10 MPa at 1375℃ for 1 hour in Ar atmosphere. The microstructure of cemented carbides was observed by SEM. The hardness of cemented carbides was measured by Vickers microhardness tester. Wear resistance was characterized by pin-on-disc type wear test.

3. Results and Discussion

The hardness of WC-TiC-10Co cemented carbides increases with increasing the TiC content and decreasing WC grain size as shown in Fig.1 (a). The hardness of WC-TiC-10Co cemented carbides shows different mechanism according to TiC content and WC/TiC grain size ratio. When the WC/TiC grain size ratio is higher than 0.8, the hardness of WC-TiC-10Co cemented carbides obey Hall-Petch type relationship. However, when the WC/TiC grain size ratio is 0.5, the hardness of WC-TiC-10Co cemented carbide is much higher than that expected by Hall-Petch type relationship. Wear resistance of WC-TiC-10Co cemented carbides increases with increasing the TiC content and decreasing WC grain size as the behavior of hardness as shown in Fig.1 (b).



(a) (b)

Fig. 1. (a) Hardness and (b) wear behavior of WC-TiC-10Co cemented carbides with varying the WC grain size and TiC content

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