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# Dissolution behavior of Ti(C,N)-based cermets with size of WC

Seoul National University Jinkwan Jung*, Shinhoo Kang

Ti(C,N)-based cermets have been introduced into the field of cutting tools because of their high hardness, strength, wear resistance and phase stability that is necessary for high temperature processing. Due to their improved mechanical properties and low price compared to WC-Co, they are currently replacing some of the cutting tools, where cemented carbide tools have previously been dominant. WC was used as a secondary carbide to enhance sinterability in sintering of cermets, inhibit grain growth and improve the mechanical properties of Ti(C,N)-based cermets.

Allegedly, size of WC does not effect on the microstructure and then mechanical properties of the final cermet products when the amount of added WC is small. However, it is not the case when large amount of WC is added. Furthermore, the dissolution of WC have been not elucidated clearly. In this presentation, dissolution behavior of WC in Ti(C,N)-50wt.%WC-20wt.%Ni(Co) was investigated In addition, several issues about shape of Ti(C,N) and WC will be presented.

In this experiment, three kinds of WC, 0.2, 0.86 and 6um, were used. After weighing starting powders, the mixtures were ball milled for 24hours with acetone, dried, sieved, and then compacted into a disc form under a pressure of 100MPa. The compacts were sintered at 1510°C for 1hr in a vacuum and the sintered specimens were mechanically ground and polished with 1~6m diamond pastes. Microstructures were observed by Image analyzer, SEM and TEM. In order to determine the regional compositions of the phases, such as the core, rim and binder, Energy Dispersive X-ray Analysis (EDXA) in conjunction with TEM was used.

In figure 1, Bigger was the size of initial WC, slower was dissolution of initial raw powders. There was remarkable difference of the volume fraction of core between 0.2 and 0.86um WC system. However, the difference is not so big between 0.86 and 6m WC system. It indicates that ultrafine WC has stronger effect on the dissolution and repricipitation than micron WC has. When Co was used instead of Ni as a binder in 6m WC system, volume fractions of core and WC was big and nearly the same with 0.2 m WC system in Ni binder system. Therefore, it can be said that binder affects remarkably on the dissolution.

During investigation, new issues were appeared as shown in figure 2. Ti(C,N) uncovered with rim and WC with concave curvature in adjunction with Ti(C,N) core or (Ti,W)(C,N) rim were discovered. These facts show that continuous dissolutoin of Ti(C,N) occurs after rims are formed and that there is Liquid Film Migration(LFM) between Ti(C,N) core or (Ti,W)(C,N) rim and WC. Mechanical properties such as toughness and hardness of system containing 6um WC was best among three systems.

Conclusively, the size of WC can affect sintering behavior and mechanical properties in system containing high content of WC.

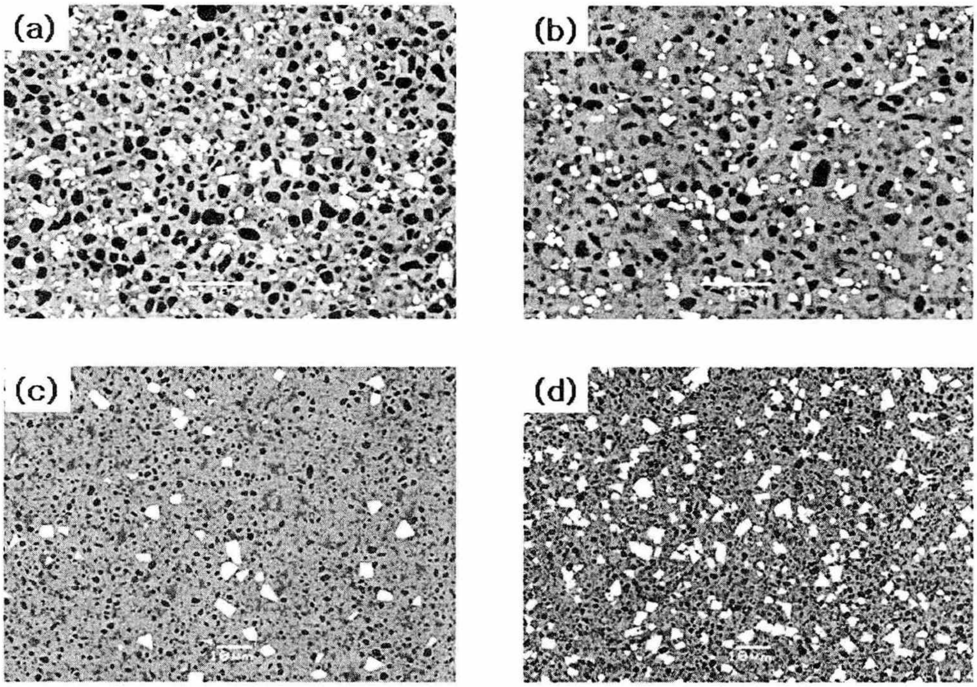


Figure 1. Micrographs of Ti(C,N)-WC(50wt.%)-Ni(20wt.%) when the size of WC is (a)0.2μ m, (b)0.86μm, and (c) 6μm is used (d)Ti(C,N)-WC(50wt.%)-Co(20wt.%) and the size of WC is 6μm.

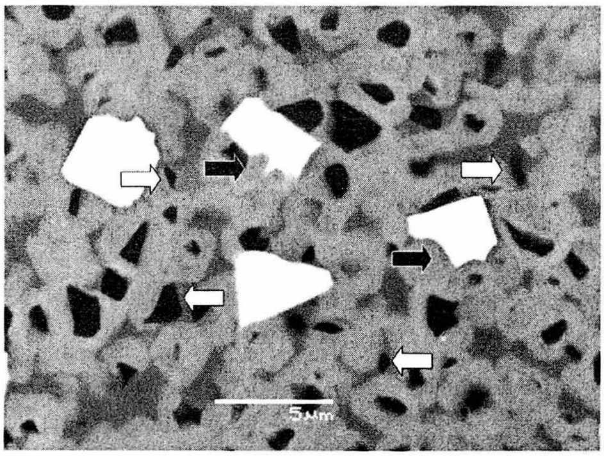


Figure 2. Micrographs of Ti(C,N)-WC(50wt.%)-Ni(20wt.%) when the size of WC is 6μm. Black arrows indicate concave curvature between (Ti,W)(C,N) and WC and white arrows indicate uncovered Ti(C,N) core.