

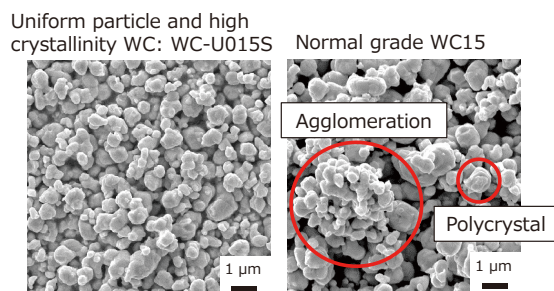
# Uniform Particle and High Crystallinity Tungsten Carbide Powder for Cemented Carbide

## 1. Outline

Cemented carbide, a hard alloy primarily composed of tungsten carbide powder (hereinafter referred to as “WC powder”), is widely used in various fields such as the automotive, aerospace, and electronics industries, due to its high hardness and wear resistance, which can reduce processing costs and time when used as cutting tools. With the increasing demand for multi-functional and high-performance components in recent times, there is a growing need for high-precision tools, prompting the demand for cemented carbides made from fine-particle WC powder that can achieve sharp shapes.

The properties of cemented carbide can be adjusted by the particle size of WC powder and the amount of cobalt (Co) present. The smaller particle size of WC powder increases hardness, while a higher cobalt content enhances strength properties such as toughness and fracture resistance. However, the characteristics of hardness and strength are interrelated, making it challenging to achieve both. Additionally, when using fine-particle WC powder as a raw material, abnormal particle growth of WC particles during sintering can occur, which becomes the initiation point for destruction and leads to unstable alloy strength. To address this, A.L.M.T. Corp. has developed WC-U015S (Fig. 1), which possesses the unique characteristics of a uniform particle size distribution with fewer particle boundaries and high crystallinity<sup>\*1</sup>, suppressing abnormal particle growth in the alloy.

### (a) Powder appearance:



### (b) Features:

- High crystallinity = Few grain boundaries
- Uniform particle size distribution

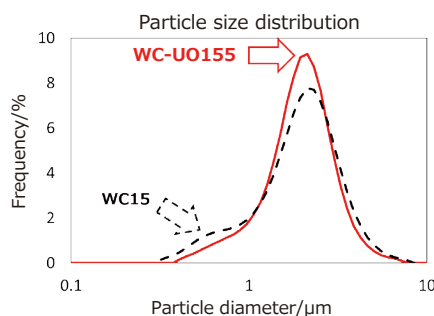


Fig. 1. Outline of uniform particle and highly crystalline WC powder

## 2. Features

### 2-1 Particle uniformity: particle growth suppression

When cemented carbides are made from fine-particle WC powder, abnormal particle growth occurs due to solid solution and reprecipitation of WC powder into the Co liquid phase during sintering; WC-U015S has uniform WC powder and a small proportion of extremely fine powder, which prevents abnormal particle growth and increases alloy strength (Fig. 2 (a)).

### 2-2 High crystallinity: improved heat dissipation

Tools made of cemented carbide come into contact with the workpiece at high speeds during machining, leading to heat generation and potential issues such as tool deformation and damage to the workpiece. Therefore, tools with excellent heat dissipation properties are desired. Within cemented carbide, thermal conduction occurs through three paths: 1) the interface between WC particles and Co, 2) within the Co phase, and 3) within the WC particles. Among these, an increased number of particle boundaries within the WC particles leads to decreased thermal conductivity. WC-U015S possesses high crystallinity with fewer particle boundaries, allowing for improved thermal conductivity of the alloy (Fig. 2 (b)).

### 2-3 High crystallinity: enhanced homogeneity in alloy

The mixing of WC powder and Co powder typically takes place using methods such as ball milling, which can cause a wider variety of particle sizes due to the cracking of WC particle boundaries. The variety in size leads to abnormal particle growth in WC particles as previously mentioned and can also cause defects known as “nests” in the alloy. By suppressing boundary cracking through high crystallinity, it becomes possible to achieve uniform particle size distribution in the alloy.

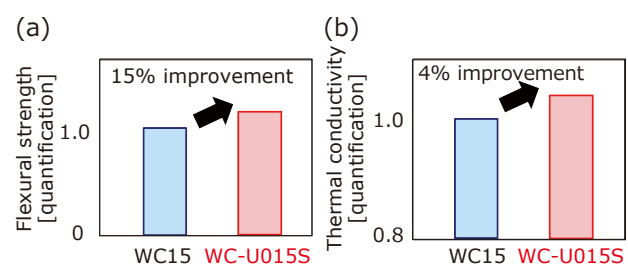


Fig. 2. Examples of property improvement when used with cemented carbide

## 3. Conclusion

In machining environments where the use of cemented carbide is transitioning from manned to automated operations in order to reduce processing costs and increase operational efficiency, there is a growing demand for further improvements in the longevity and reliability of cemented tools. A.L.M.T. Corp. expects that the uniform particle size

and high crystallinity WC powder will greatly contribute to enhancing the properties of cemented carbides by ensuring the high quality of the WC powder used as raw material.

\*1 High crystallinity: One particle is composed of a small number of crystals.