

## Accepted Manuscript

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PII: S0263-4368(17)30326-8

DOI: doi: [10.1016/j.ijrmhm.2017.07.012](https://doi.org/10.1016/j.ijrmhm.2017.07.012)

Reference: RMHM 4482

To appear in: *International Journal of Refractory Metals and Hard Materials*

Received date: 23 May 2017

Revised date: 21 July 2017

Accepted date: 23 July 2017

Please cite this article as: Haixia Tian, Yingbiao Peng, Yong Du, Lianchan Qiu, Cong Zhang , Thermodynamic calculation designed compositions, microstructure and mechanical property of ultra-fine WC-10Co-Cr<sub>3</sub>C<sub>2</sub>-TaC cemented carbides, *International Journal of Refractory Metals and Hard Materials* (2017), doi: [10.1016/j.ijrmhm.2017.07.012](https://doi.org/10.1016/j.ijrmhm.2017.07.012)

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Thermodynamic calculation designed compositions, microstructure and mechanical property of ultra-fine WC-10Co- Cr<sub>3</sub>C<sub>2</sub>-TaC cemented carbides

Haixia Tian<sup>a</sup>, Yingbiao Peng<sup>b</sup>, Yong Du<sup>a,\*</sup>, Lianchan Qiu<sup>a</sup>, Cong Zhang<sup>a</sup>

<sup>a</sup> State Key Lab of Powder Metallurgy, Central South University, Changsha, Hunan 410083, China

<sup>b</sup> College of Metallurgy and Materials Engineering, Hunan University of Technology, Zhuzhou 412007, China

\* Corresponding author. Tel.: +86 731 88836213; fax: +86 731 88710855;

E-mail address: yong-du@csu.edu.cn (Y.Du).

## Abstract

The grain size of WC and the content of inhibitors are two critical factors responsible for mechanical properties of cemented carbides. Cr<sub>3</sub>C<sub>2</sub> and TaC grain-growth inhibitors are added simultaneously to control the grain growth of ultra-fine WC-Co cemented carbides. The content of doping inhibitors should be controlled strictly, below the maximum solubility in the binder phase, to avoid the appearance of free carbides, which cause brittleness and thus have a negative influence on mechanical properties. In this work, several ultra-fine WC-10 wt.%Co cemented carbides with various contents of Cr and Ta were designed and fabricated via combining thermodynamic calculations and key experiments. With the addition of Cr<sub>3</sub>C<sub>2</sub> and TaC to a certain extent, the density, transverse rupture strength, hardness and fracture toughness of WC-Co cemented carbides are improved significantly. However, excessive Cr<sub>3</sub>C<sub>2</sub> and TaC lead to the formation of M<sub>7</sub>C<sub>3</sub> as well as coarse (Ta,W)C grains, which deteriorates the mechanical properties. Based on thermodynamic calculations, a favorable addition of inhibitors can be established, which enables an effective control of microstructure and mechanical properties.

## Keywords

Cemented carbides; Grain-growth inhibitor; Thermodynamic calculations; Maximum solubility; Mechanical property

## 1. Introduction

Ultra-fine WC-Co cemented carbides possess good hardness and toughness as well as a better wear resistance than traditional cemented carbides. Consequently, they are

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