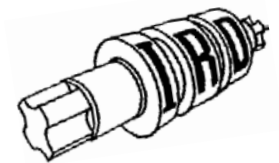




Microstructure and Performance of Carbide Roll for High-speed Wire Mill

- Zhu Zhou Cemented Carbide Group Corp. Ltd., P.R. China
- State Key Laboratory of Cemented Carbide, P.R. China

Institute of Roll Design



CONTENTS



01 Background

02 Preparation of carbide roll

03 Microstructure and properties

04 Outlook



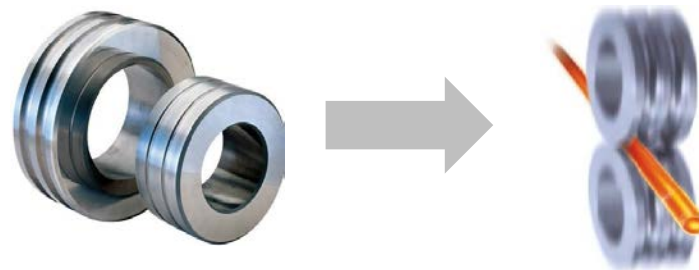
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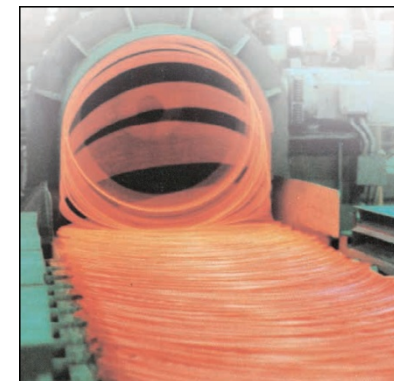
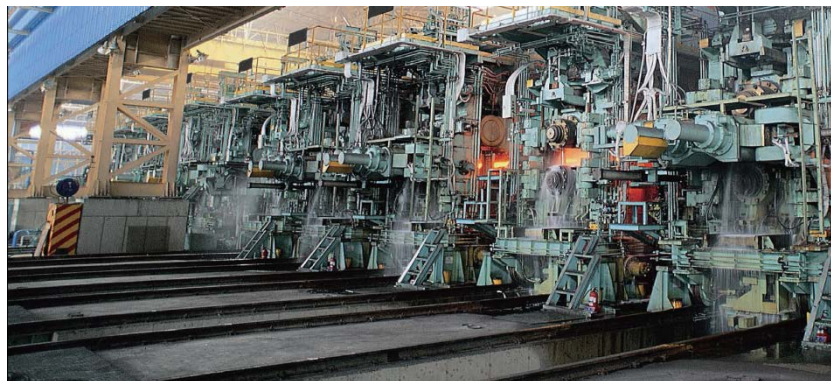
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1. Background

Carbide roll



- ◆ Carbide roll are the consumables required for wire rolling in the steel industry
- ◆ The performance of the carbide roll directly affects the quality of the rolled wire



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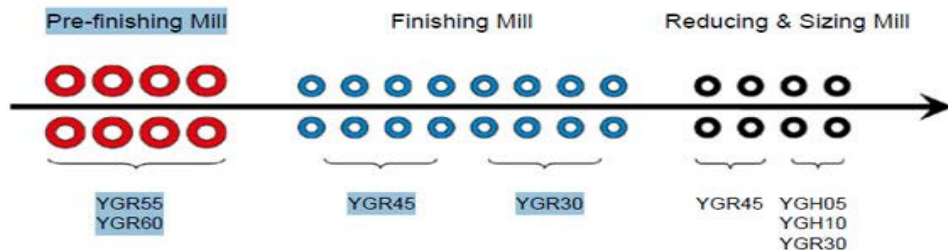
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1. Background

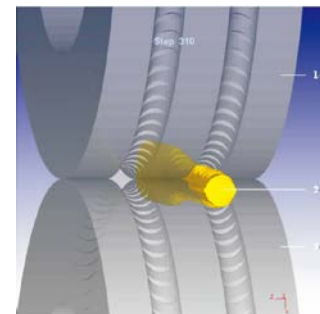
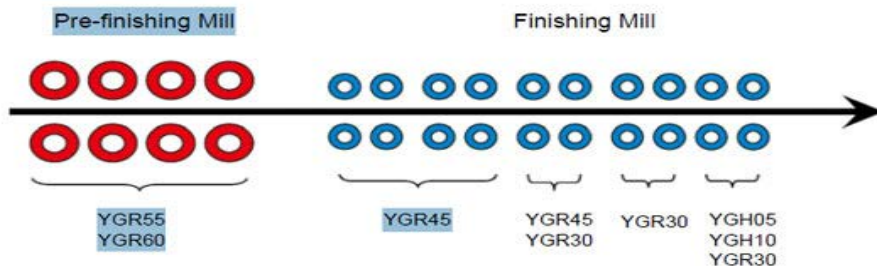
Some high quality steel wire rods need to be rolled to complete

Rolling at a temperature in the range of about 700 to 1100 °C

1. Rolling mills with reducing & sizing mill



2. Rolling mills without reducing & sizing mill



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1. Background



Low rolling tonnage
High production costs



Poor surface quality



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CONTENTS



01 Background

02 Preparation of carbide roll

03 Microstructure and properties

04 Outlook

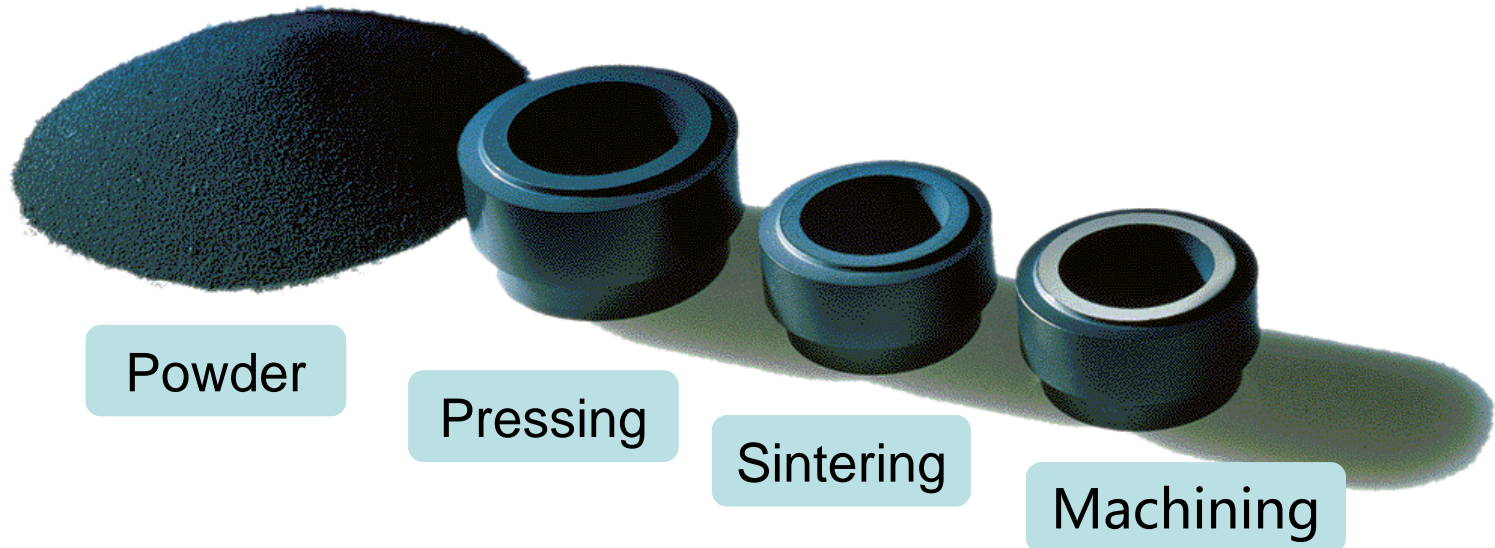


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2. Preparation of carbide roll



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CONTENTS



01 Background

02 Preparation of carbide roll

03 Microstructure and properties

04 Outlook

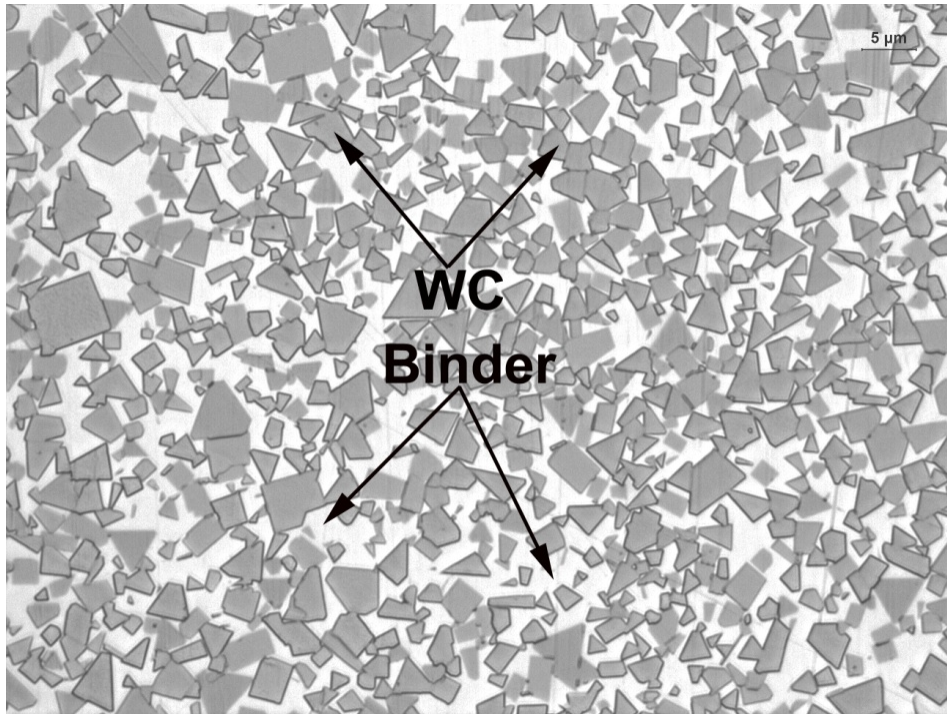


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3. Microstructure and properties



Microstructure

The properties of the material depend on its internal microstructure

WC grain size, distribution

WC grain morphology



Properties

The evolutionary information of microstructure plays an important role in interpreting material properties.

Fracture toughness

Hardness

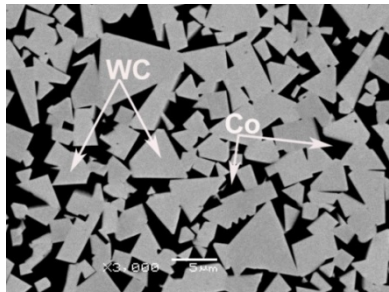
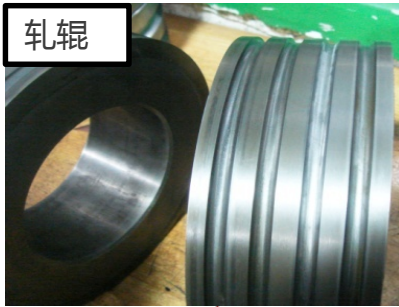


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3. Microstructure and properties



Coarse grain WC-Co cemented carbide

Widely applied to carbide roll

Excellent toughness

Excellent thermal conductivity

Excellent impact resistance

Excellent thermal fatigue resistance

Coarse grain WC-Co cemented carbide refers to cemented carbide with WC grain size of 2.5-6.0 μm

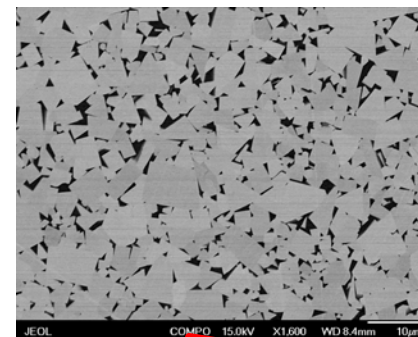
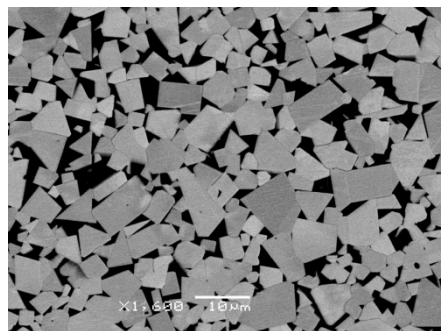


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3. Microstructure and properties



Grade	Recommended stand	Chemical composition /wt%		Density /g·cm ⁻³	Hardness /HRA	Bending strength /MPa	Compressive strength /MPa	Fracture toughness /MPa·m ^{1/2}	Thermal conductivity /W·(m·K) ⁻¹
		WC	Binder phase						
1#	Size stand	94	6	14.90	89.0	2 400	4 500	14	110
2#	Finishing rolling stand(last two)	90	10	14.50	86.0	2 500	3 800	18	105
3#	Finishing rolling stand(last four)	85	15	14.00	84.5	2 700	3 800	22	100
4#	Finishing rolling stand(front four)	80	20	13.50	81.5	2 600	3 300	24	95
5#	Pre-finishing	75	25	13.00	80.0	2 400	3 100	25	90

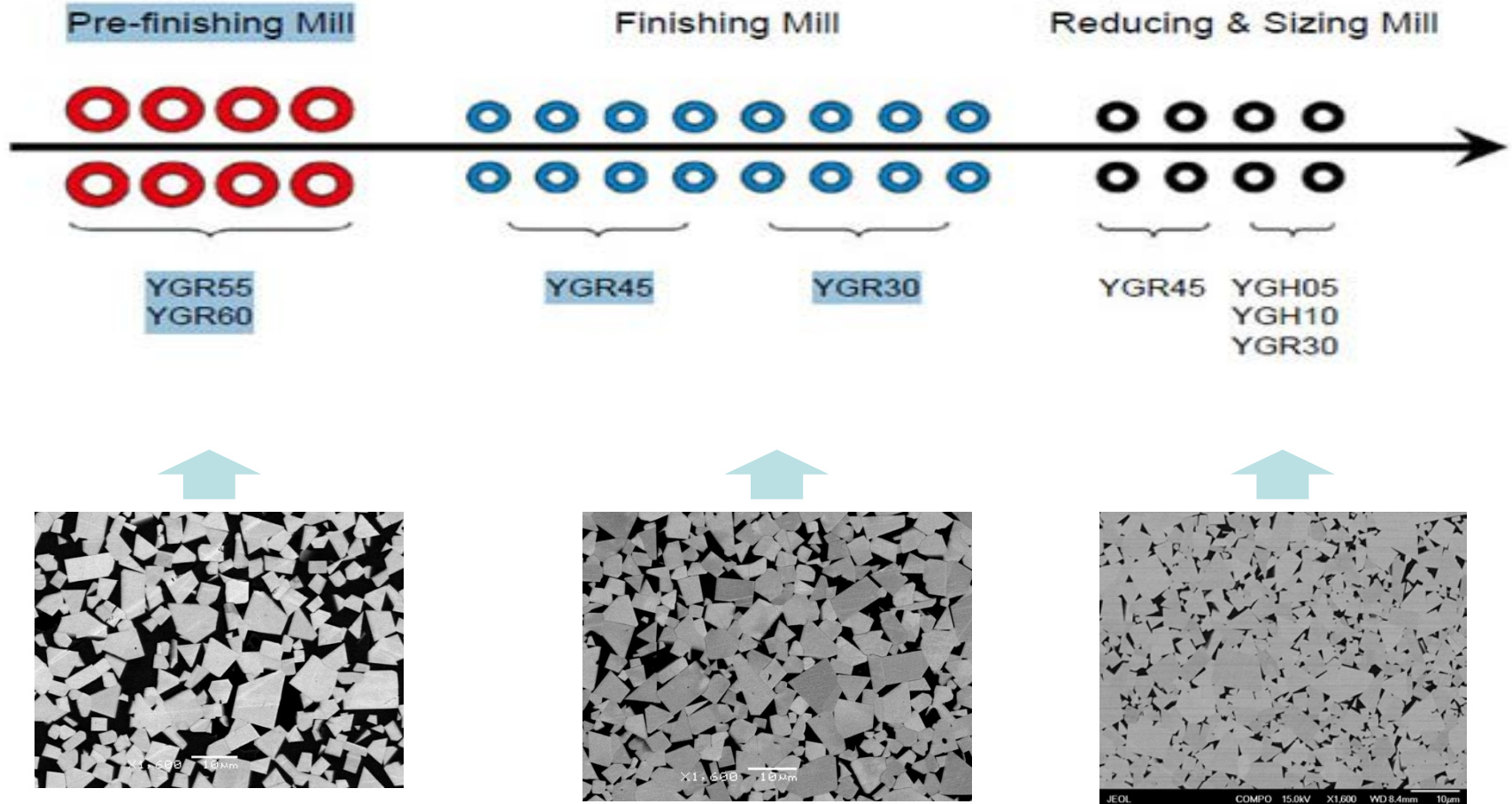


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3. Microstructure and properties



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3. Microstructure and properties

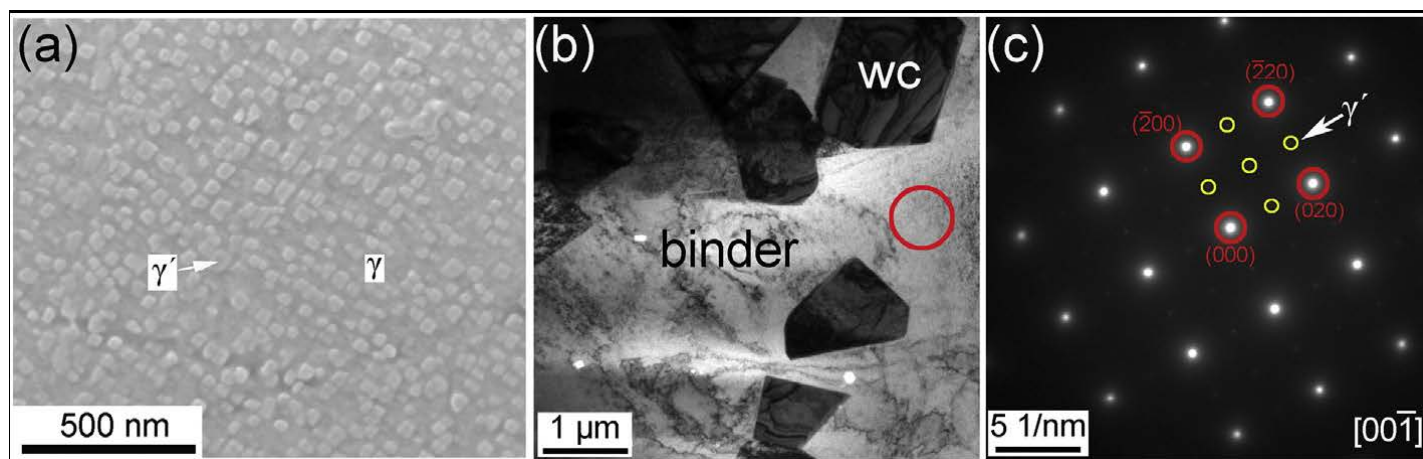
1.Co-based binder phase

2.Co-Ni-Cr-based binder phase

3.Co-Ni-Al-based binder phase

Recent research progress

binder phase



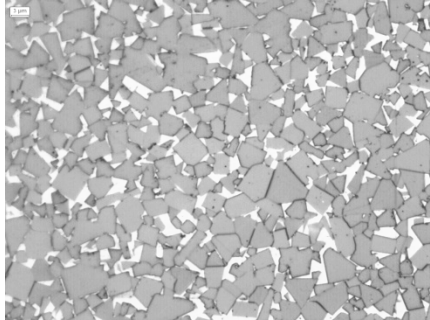
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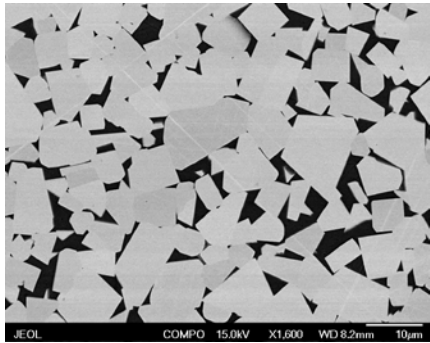
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3. Microstructure and properties

Grain morphology and particle size distribution of WC



Homogeneous structure

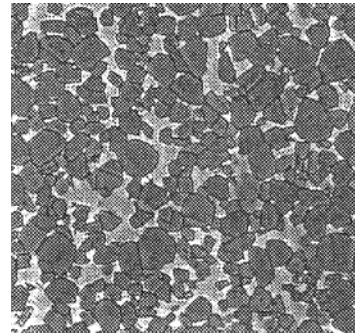


Ultra-coarser crystal structure

Recent research progress



Double-crystal structure,



Round grain WC structure



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CONTENTS



01 Background

02 Preparation of carbide roll

03 Microstructure and properties

04 Outlook



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4. Outlook

In the selection of carbide roll grades, while taking into account the wear resistance of the alloy, the temperature field and stress field of the carbide roll during the rolling process are simulated by computer according to the condition of each stand to realize the optimal design of the roll material. The optimization provides a good reference for each stand.

The types and contents of the elements in rolled wires are different, and the affinity of the elements of carbide roll is different, resulting in different wear mechanisms. Therefore, it is necessary to strengthen the research on this mechanism.



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THANKS!



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