SPECIALTY CARBONS FOR **HARD METALS**

ENSACO®
Carbon Black

TIMREX®
Graphite

IMERYS

HARD METAL – MATERIAL SOLUTIONS FOR THE MOST DEMANDING APPLICATIONS

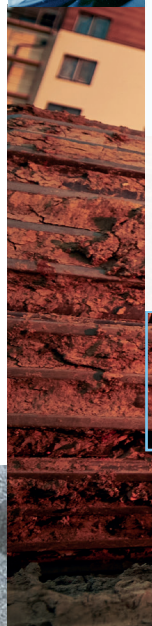
INNOVATIVE LEADERSHIP

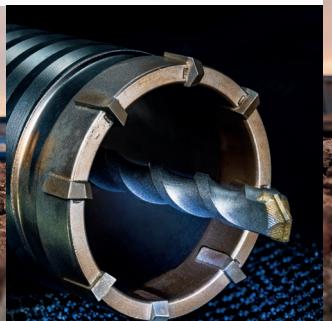
Innovative leadership and capabilities make Imerys Graphite & Carbon the right partner for the development and optimization of solutions for the production of hard metal, such as tungsten carbide (WC).

Imerys Graphite & Carbon has been serving this market for more than two decades, always aligning to new developments and opportunities with respect to final applications such as:

- Cutting tools for machining
- Mining
- Foundation drilling
- Engineered components
- Carbide drills
- Turning, milling and metal working tools

Close collaboration with customers allows us to fine tune solutions to meet their specific needs. Our product portfolio includes graphite and carbon black powders of the highest quality and consistency. In addition, our sophisticated production processes allow for exceptional control of key product parameters including purity, crystallinity, particle size distribution, and oversize particles.

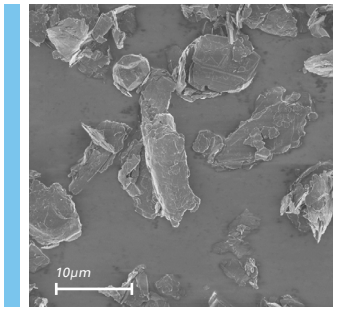




IMERYS GRAPHITE & CARBON SOLUTIONS FOR HARD METALS

PRIMARY SYNTHETIC GRAPHITES

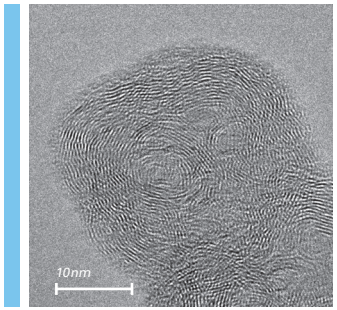
Imerys TIMREX® line of fine grade primary synthetic graphites, including KS4, KS6, KS15, can be offered with tailored specifications with respect to the level of impurities such as sulphur, calcium, silicon or iron, which are detrimental for hard metal production.



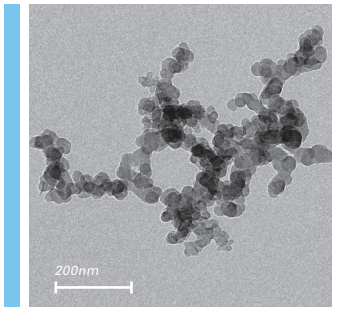
TIMREX® KS15 Primary synthetic graphite

HIGH STRUCTURE CARBON BLACK

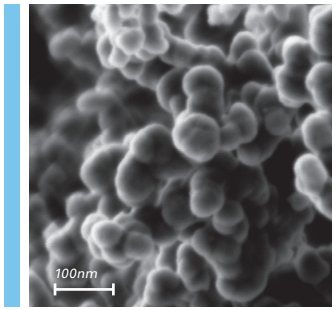
To complement our line of graphite powders, we also offer high purity carbon black with high BET. The high reactivity of ENSACO® carbon black makes it particularly suitable for the synthesis of nano-sized WC powders starting from tungsten oxide.



Carbon black primary particle



Carbon black aggregate



Carbon black agglomerates

Carbon black TEM images (ENSACO® 250G)

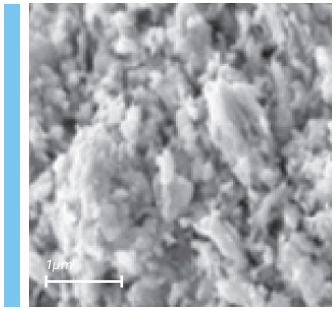
CUSTOMIZABLE SOLUTIONS

KEY REQUIREMENTS	BENEFIT FROM IMERYS	RECOMMENDED GRADE
High purity	High purity	Primary synthetic graphites: TIMREX® KS 15
Small WC grain size	Tailored particle size distribution	
Efficient carburization activity	Carburization at low temperatures	Carbon black: ENSACO® 250G

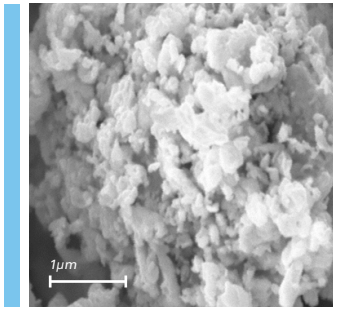
TUNGSTEN CARBIDE (WC) PRODUCED FROM METALLIC TUNGSTEN POWDER (W)

Inert atmospheres are recommended for the synthesis of WC when metal W powders are used as precursors. In these conditions, fine WC powders can be obtained at 1100°C using either graphite or carbon black powders.

The resulting WC powders consist of agglomerates of submicron particles with irregular platelet morphology.



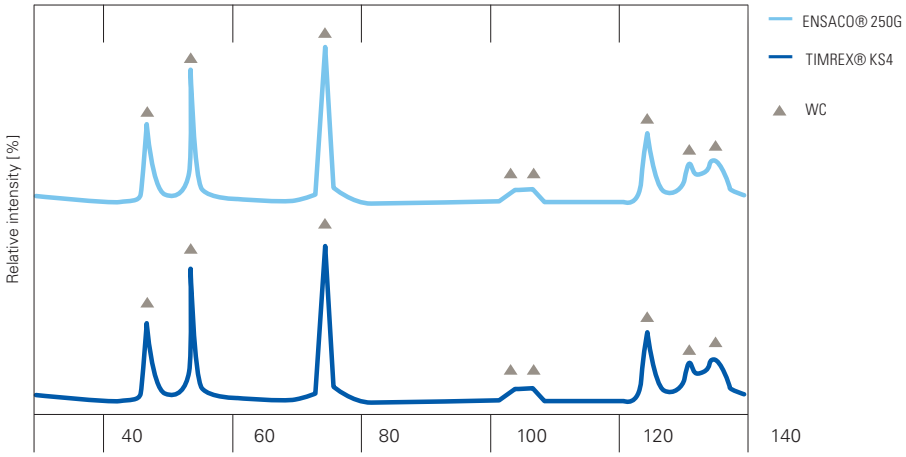
Tungsten and TIMREX® KS4 Mix



Tungsten and ENSACO® 250G mix

SEM patterns of WC powders obtained after carburizing W+C mixes under Argon at 1100°C

XRD patterns of WC powders obtained after carburizing
W+C mixes in Ar at 1100°C – 30 min



	WC POWDERS OBTAINED FROM W	
	TIMREX® KS4 GRAPHITE	ENSACO® 250G CARBON BLACK
BET (m^2/g)	2.67	2.55
Grain size (nm)	144	151
Sulphur (ppm)	31	20

TUNGSTEN CARBIDE (WC) PRODUCED FROM TUNGSTEN OXIDE POWDER (WO_3)

It is possible to synthesize WC directly from WO_3 powders. In this case, atmospheres containing hydrogen are needed to activate the reduction of oxides at lower temperatures, whereas reduction at higher temperatures is promoted by the presence of carbon.

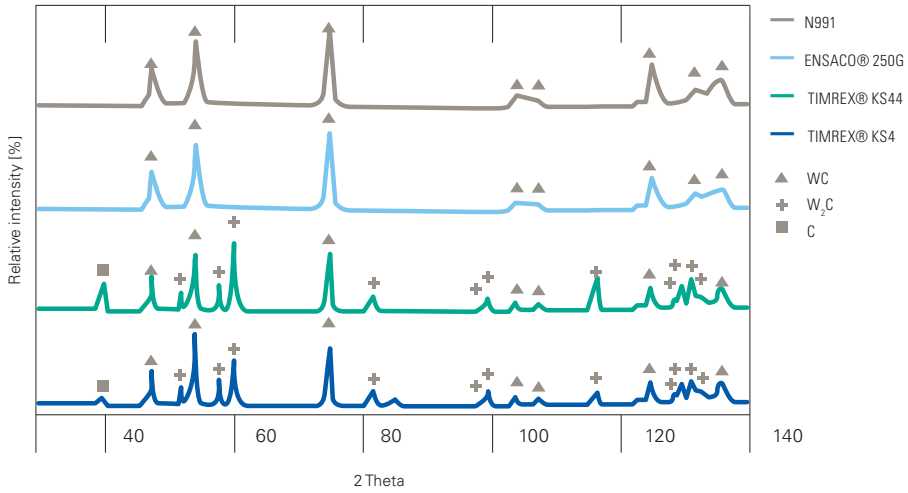
Carburization reaction takes place at lower temperatures for carbon black (**ENSACO® E250G** < N991) compared to graphite.

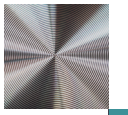
Carburization of mixtures containing WO_3+ Carbon black in Ar–50%H2 is complete at 1100°C, whereas for WO_3+ graphite powders complete transformation to WC is achieved at higher temperatures (1300°C).

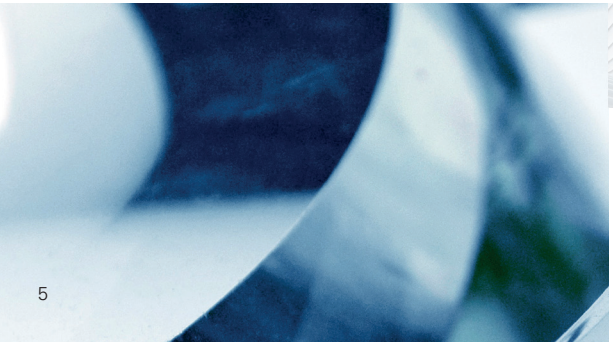
The resulting WC powders have spherical morphology, sub-micron particle size and crystalline grain sizes below 30 nm (estimated by XRD). The BET surface area is higher compared to WC powders obtained by metallic W.

In particular, **ENSACO® E250G** gives much higher BET values compared to N991, indicating a finer grain size (around 60 nm according to TEM).

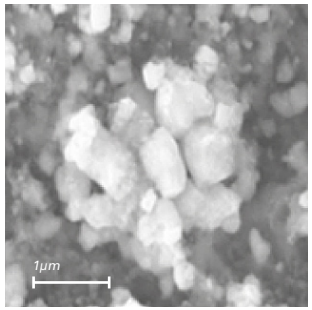
XRD patterns of WC powders obtained after carburizing WO_3+ C mixes in Ar – 50% H2 at 1100°C



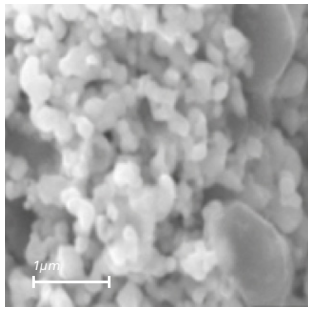




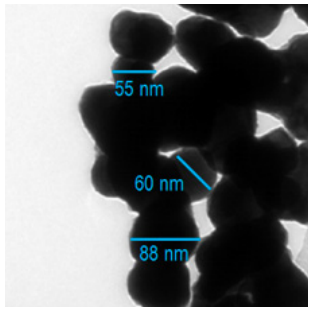
TUNGSTEN CARBIDE (WC) PRODUCED FROM TUNGSTEN OXIDE POWDER (WO_3)



ENSACO® 250G



N991 – Competitor carbon black



TEM microscopy study of WC from WO_3 and E250G

SEM pictures of WC powders obtained after carburizing W+C mixes under Argon at 1100°C

	WC POWDERS OBTAINED FROM WO_3	
	N991 – COMPETITOR CARBON BLACK	ENSACO® 250G CARBON BLACK
BET (m^2/g)	2.92	6.90
Grain size (nm)	131	56
Sulphur (ppm)	22	18

EXPERIMENTAL CONDITIONS

Tungsten metal powder (W) and Tungsten oxide powder (WO_3) have been mixed with different carbon powders (**ENSACO® 250G** and N991 carbon blacks, **TIMREX® KS4** and **TIMREX® KS44** graphites) for 2 hours at 300 rpm in a Fritsch Pulverisette planetary mill. Carburization has been performed in a Netzsch DIL402C dilatometer.

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