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DETERMINATION OF AVERAGE SIZE AND VOLUME FRACTION OF CARBIDES IN AISI T15 HIGH SPEED STEELS

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High speed steels have been widely used as cutting tools due to their mechanical properties as compared to other steels and their toughness as compared to ceramic materials and sintered carbides. A specific type of microstructure is required in these steels [1-2].

The microstructure of high speed steels consists of MC and M_6C type primary carbides, where M is the metal, in a quenched martensitic matrix. Determination of the austenite grain size and the amount of carbides present are essential for evaluating the properties of these steels.

This paper is restricted to the determination of carbides of an AISI T-15 vacuum sintered by two different methods of quantitative metallography. This determination is fairly complex and cannot be carried out by automated equipments since the density values of carbides MC and of the matrix are too close and, consequently do not present sufficient contrast for analysis. Both the methods are based on the processing of digital images. Five different areas were evaluated to obtain statistically representative results. Besides, the use of backscattered electron image (composition image) made it possible to distinguish the M_6C (white) from MC (grey) carbides, and this enables subsequent image analysis, without previous metallographic attack.

The first method is based on an image processing software "AnalySIS 2.1" [3] of a Philips XL-30 scanning electron microscope.

The second method, titled "Quantikov" was designed to integrate the capabilities of a "Windows" platform for microstructural image analysis, aimed at automating the process to quantify microparticles from the digitized images obtained with a "scanner". This capability permits the grain boundaries and/or carbides, (transported manually by the researcher from the respective micrographs to the transparencies), to be recorded by a "scanner" and analysed [4].

The results are shown in Table I. Differences can be observed, between the measurements made by "Quantikov" and the image analysis software of the scanning electron microscope. These are mainly due to different regions of the specimen having been examined. Figure 1 also reveal large variations in size, not only of the MC carbides but also of the M_6C carbides. Magnification: 1500x and 3000x.

REFERENCE

(1) Hoyle, G., High speed steels, Butterworth & Co., UK. 1998.
(2) Nogueira, R.A., et all, Microstructural Evaluation of AISI T-15 High Speed Steel, submitted to the 2nd International Latin-American Conference of Powder Technology, 10-12 nov. 1999 Foz Iguaçu Br.
(3) Image analysis software manual of Philips XL-30 SEM
(4) Pinto, L.C.M., Doctorate thesis, IPEN-USP. 1996.

Table I. Average size and volume fraction of MC and M_6C.

Types of carbide	ANALYSIS 2.1/ SEM			QUANTIKOV		
	Average size (μm)	Volume fraction (%)	Total number of carbides observed	Average size (μm)	Volume fraction (%)	Total number of carbides observed
MC	1.4 ± 0.3	6.2	251	1.6 ± 0.1	7.6	219
M_6C	1.2 ± 0.1	4.5	365	1.1 ± 0.5	5.7	470

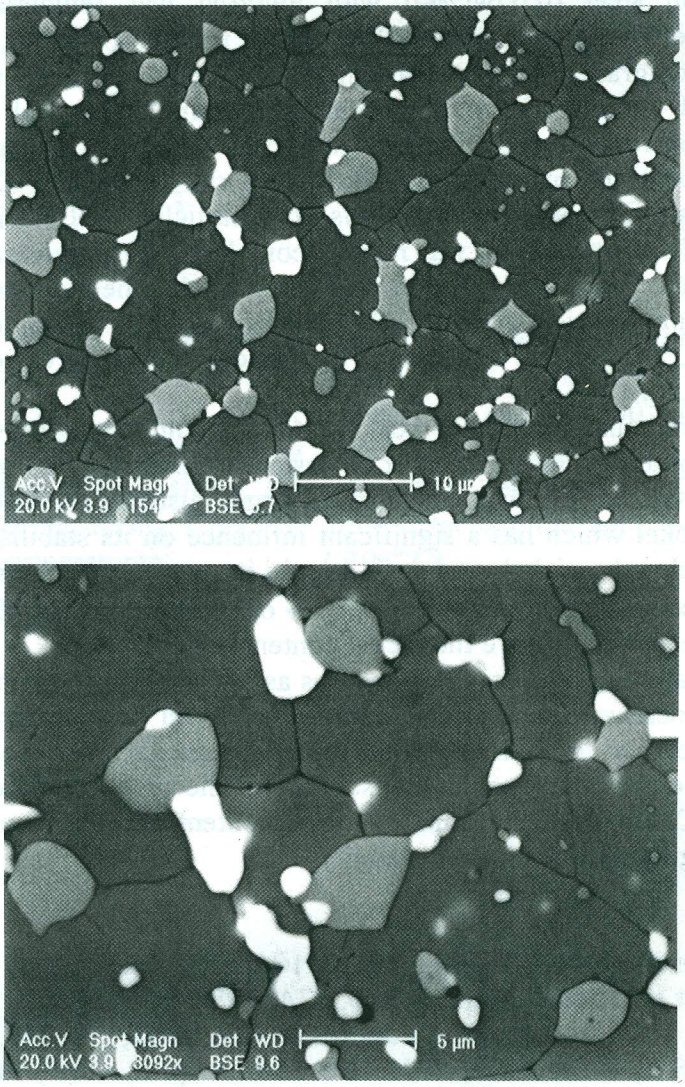

Figure 1. Scanning electron micrographs of high speed steel AISI T15.