Acta Microscopica, Vol. 8 Supplement A October 1999
Proc. XVII Congress of the Brazilian Society for Microscopy and Microanalysis and X Congress of the Brazilian Society for Cell Biology

MICROSTRUCTURAL CHARACTERIZATION OF Al-Si ALLOY USED IN AUTOMOBILE INDUSTRY

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The objective of this work was the microstructural characterization of Aluminum-Silicon (Al-Si) alloy used in automotive pistons manufacture. This work is a preliminar study of transformation hardening by laser superficial treatment (LST) that has been done in order to improve some properties of the Al-Si alloy. The information of the microstructure found in this work will be useful in the choice of the LST parameters and in the comparison with the microstructure hardened by laser radiation.

The basic chemical composition (wt. pct.) of this alloy is 12Si, 1.5Cu and balance Al.

A preliminary examination of the as polished sample (retired from piston) was done because etching can obscure, as well as, reveal important details as fine cracks and nonmetallic inclusions. Then, sample was etched in HF (5 pct.) for approximately 15 seconds and analyzed by scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS).

Figure 1 represents the microstructural features of Al-Si alloy as polished sample observed by SEM. The microstructure consists of primary α-Al dendrites surrounded by an interdendritic network of eutectic silicon (light gray) and primary silicon (dark gray) particles.

The etched microstructure is illustrated in Figure 2. Besides the microconstituents identified in Figure 1, the eutectic matrix (Chinese-script) contains rounded particles of $CuAl_2$, Mg_2Si, $NiAl_3$ and other non identified ones. Figure 3 shows the EDS of this round particles.

The presence of primary silicon particles in the matrix is responsible for the great hardness (128HV) of the alloy, but it led to inferior wear properties due to a predominating embrittling effect and microcracking tendency. The lower tensile strength and elongation of this material is also caused by the presence of these particles. Because of this, an amount of phosphorus has been additioned by the manufacturer. However, microstructural refinement and reduced porosity, that can

be obtained by laser superficial treatment, could improve some properties of this alloy such as yield strength, ductility, fatigue and wear resistances and consequently the piston performance in service.

Acknowledgments: Thanks to METAL LEVE for supplying the piston used in the accomplishment of this work and CNPq for the financial support.

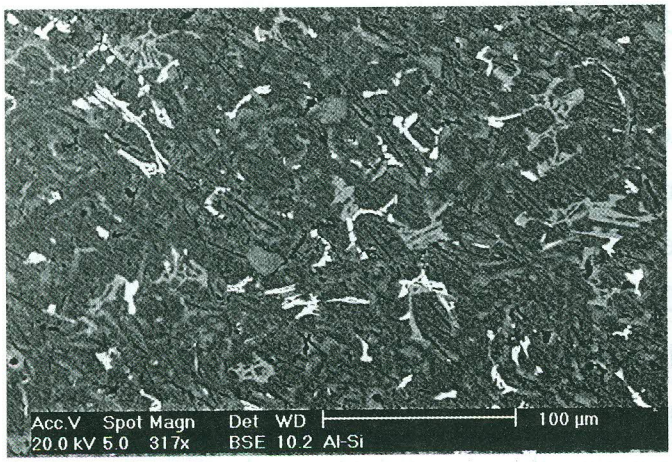

Figure 1 - SEM of Al-Si; as-polished.

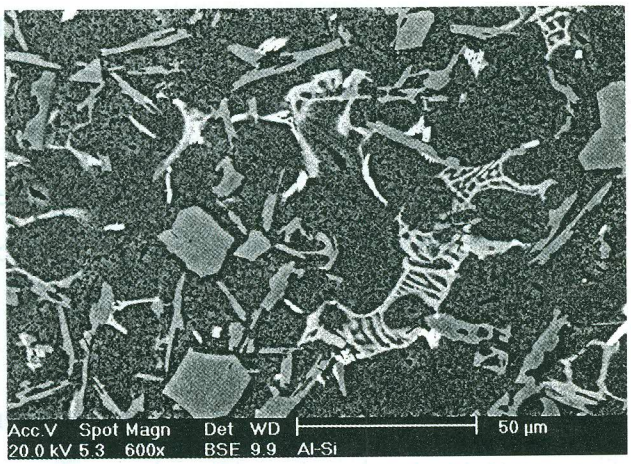

Figure 2 - SEM of Al-Si etched (HF, 5 pct.).

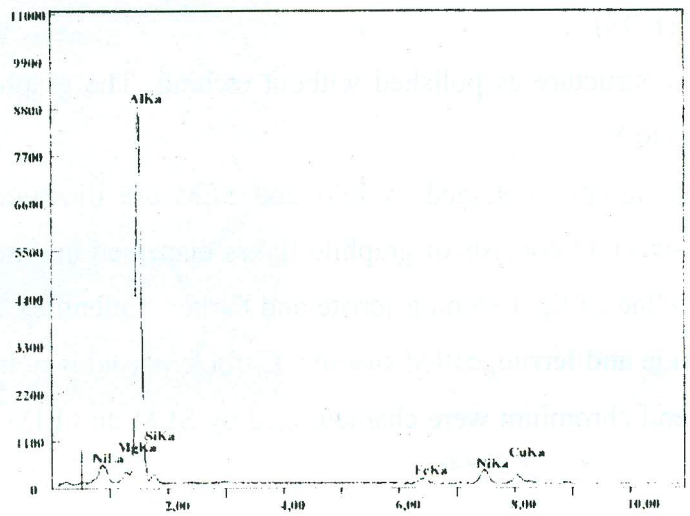

Figure 3 - EDS of round particles.