THE FUTURE OF CHARACTERIZATION OF METALLIC MATERIALS: EBSD ANALYSIS OF A HEAT TREATED NODULAR CAST IRON

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ABSTRACT:

The knowledge of the properties of the materials comes mainly from understanding the characterization of the microstructure. Among the techniques used, the analysis of electron backscatter diffraction (EBSD) has a positive perspective for the future of microstructural studies of metallic materials. This technique allows obtaining quantitative information on the microstructure. The morphology, grain size, volumetric fractions, texture, and crystallographic orientation, being key elements in the understanding of phase transformations caused by heat treatments. On the other hand, heat treatments are of high technological interest because they allow high gains in properties representing a small portion of the processing cost. Alternatively, to austempering, tempering and partitioning have had appreciable results in nodular cast irons. In this work, the main objective was the microstructural characterization of a nodular cast iron SAE D5506 processed by tempering and partitioning by EBSD analysis. The raw cast iron was characterized by optical microscopy, being determined by the degree of nodularization (ISO 945-1), phase proportion (ASTM E562), and the number of nodules/mm^2 (ASTM A247). In the heat treatment of tempera and partitioning, as samples were austenitized at 900°C for 2h. They were then cooled in partial seasoning at 170°C for 2 minutes (in a salt bath) and were partitioned with temperatures of 230°C and 370°C for 2h. After a new metallographic preparation, Rockwell hardness and Vickers microhardness measurements were performed. For the EBSD scan, polishing with colloidal-silica suspension was performed in the preparation of the samples. Each EBSD scan was performed with the sample tilted at 70° about the horizontal one, with a step of 0.4 µm. The indexed phases were ferrite and austenite, not indexing the points occupied by graphites. The quantitative metallography of the raw cast iron samples obtained a nodularization degree of 93 ± 0.5%. The phase proportion was 57.1% ferrite and 42.9% perlite, considering the normalized matrix to 100% and discounting the areas filled by graphite nodules. The number of nodules/mm^2 obtained was 120 ± 21. These values, when compared to similar studies in the literature, showed similarity. The samples obtained higher hardness for the partition level at 230ºC when compared to 370ºC, due to the influence of heat treatment parameters, obtaining a more refined microstructure. The combination of martensite and austenite, after heat treatment, allows a synergistic action of tensile and elongation properties. The EBSD analysis allows observing the indexation of the inherent diffraction pattern of the samples. Besides, EBSD is an important technique for phase and crystallites orientation mapping. It is possible to conclude that the metallographic preparation of processed materials has a direct influence on indexing patters. Thus, it affects the properties of metallic materials.

Keywords: EBSD; Heat Treatments; Metallic Materials; Nodular Cast Irons

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