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Analysis of surface on machinery grade steel Boriding

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The AISI 9254 steel is used in industrial applications in machine building parts, plastic molds and zinc casting dies. Because the current conditions of use on steel and the need to improve its mechanical properties, surface treatments have been carried to extend the service life of the parts manufactured on this steel [1, 2]; Therefore, thermochemical treatment is a surface modification alternative with the intention of obtaining a FeB/Fe_2B bilayer and/or FE_2B monolayer, in order to contribute with quantitative and qualitative properties for possible industrial applications [3, 4, 5, 6]. Thus, this work reports the boriding process by dehydrated paste, in addition to the microstructural characterization and the mechanical property of hardness on the surface of the substrate exposed surface processing.

Using AISI 9254 steel with chemical composition in percentage of C, 0.51-0.59, Mn, 0.60-0.80, P max 0.035, S max 0.040, Si, 1.20-1.60 and Cr, 0.60-0.80; obtained specimens with dimensions diameter 2.54 cm and thickness 1.00 cm, exposed to temperature of 1000 °C for 9 h, by paste dehydrated boriding process (BPD-9) in a conventional furnace without inert gas [7]. Microstructural surface characterization was performed by optical microcopy with the GX71 OLYMPUS Inverted System Metallurgical Microscope. The adhesion of the surface obtained was evaluated by means of the VDI 3198 standard using the Daimler-Benz Rockwell-C [8]. In addition, the surface morphology was analyzed by scanning electron microscope (EDS) using Jeol JSM-6010LA equipment. The formation of phases on the surface were examined by X-ray diffraction (XRD) with equipment Bruker D8 Advance, Cu radiation Kα λ=1.5406 Å. Using Wilson® Hardness TUKONTM 1102 equipment, the hardness was evaluated by nanoindentation test on the surface of the material exposed to boriding. For nanoindentation, it was used a load of 100 mN.

Figure 1a shows the microscopy micrograph of the substrate and Fe_2B/FeB iron borides formed on the surface by the BPD-9 process. As is evident, the Fe_2B/FeB borides have a sawn morphology. In addition, time and temperature BPD-9 evidenced Fe_2B with a thickness of 87.8490 ± 9.0964 µm and FeB with a thickness of 24.1679 ± 2.1949 µm. Figure 1b indicates the adhesion quality of the surface layer obtained in BPD-9 shows a delamination at the indentation mark and matches HF3. This evidences a typical correlation with saw tooth morphology, shown Perrusquia N. et. al [7]. Figure 2a by SEM-EDS shows analysis of the alloying elements identified on FeB/Fe_2B iron borides. Figure 2b shows the results of the X-ray spectra of borides on the surface in the study material, FeB, Fe_2B and B_2Cr were formed.

The microhardness results obtained show for FeB 2160.0 ± 136.9 HV and in Fe_2B 1826.9 ± 179.4 HV. The cause of the increased hardness in iron borides is caused by the distribution of the alloying elements in the iron borides obtained by BPD-9 treatment. Surface analysis on steel exposed to BPD-9 shows to obtain saw-tooth morphology of FeB/Fe_2B coating and by adhesion quality test shows to be compatible with HF3 in this study.

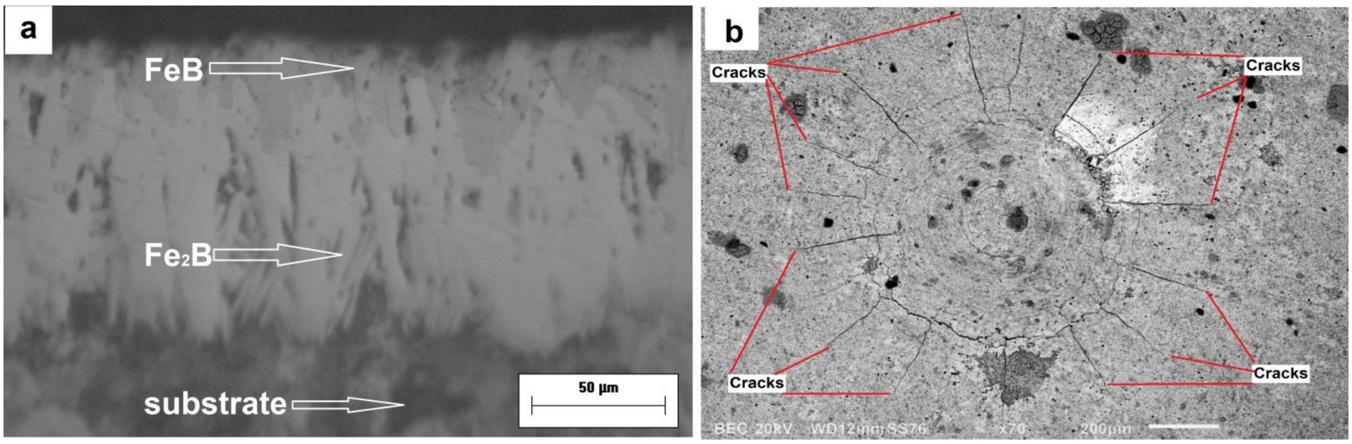

Figure 1. (a) Surface microstructure results on 9254 steel exposed to DPB-9 and (b) SEM images of the adhesion test for 9254 steel with DPB-9.

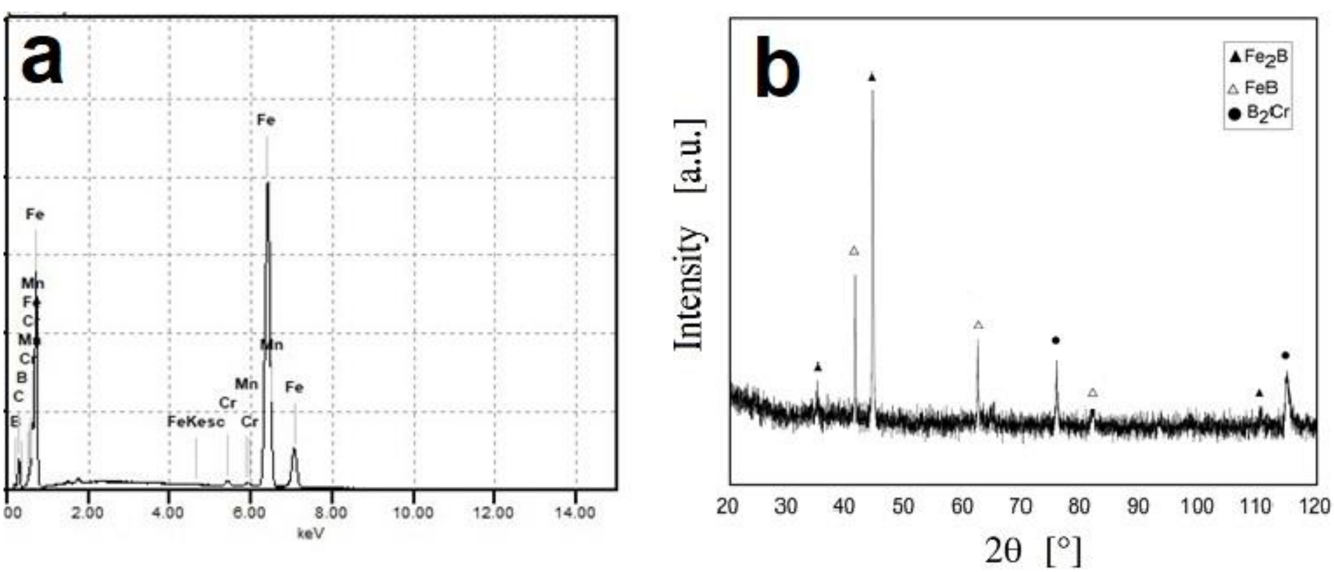

Figure 2. (a) Scanning EDS analysis for 9254 steel with DPB-9 and (b) XRD patterns obtained on 9254 steel exposed DPB-9.

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