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Characterization of Microstructure Obtained by Boronitriding of an AISI H13 Steel

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Duplex treatment boronitriding on surface AISI H13 can change the chemical composition and microstructure of a relatively hard layer by diffusion in nitrogen and boron element, and improve the mechanical, physical, and chemical properties [1,2]. The evolution on microstructural characteristics on surface of AISI H13 steel have been studied by boronitriding as performed by dehydrated paste pack boriding (DP-PB) followed salt bath nitriding on surface AISI H13.

Specimens sizes of commercial AISI H13 steel with dimensions of a diameter of 12.7 mm and 10 mm thickness, then ground up to 1200 grit surface finish before duplex treatment. Boronitriding was performed in two processes; Firstly, samples H13 steel were packed in the dehydrated paste with a minimum of 10 mm of dehydrated paste coverage, sealed in a stainless steel container and place inside a resistance furnace without the use of a controlled atmosphere. The boriding treatment was carry out at 1173 K for 3 h. Secondly, samples of H13 steel borided were nitride according to “tenifer bath nitriding” at 853 K for 1.5 h. In each process, the cooling was at room temperature. In addition, the samples were sectioned by diamond saw and resin embedded, polished using standard metallographic techniques and then etched with 2% nital solution to reveal their cross-sectional microstructure. The microstructures were examined by scanning electron microscopy (JEOL JSM-6010LA) and phases on each conditions were identified by X-ray diffraction (XRD) technique by 35kV and 25 mA with Cukα radiation. The diffraction test was under taken by scanning from 20^o to 100^o for phase characterization on each condition.

Figure 1a shows a view cross-sectional SEM image on H13 steel borided, the morphology of the boride layers depicted is somewhere saw-toothed structure with the FeB/Fe_2B and Fe_2B/substrate interface. A total layer thickness of 33.95±7.2 µm with 14.6±5.2 µm for FeB and 19.3±6.8 µm for Fe_2B. The cross-section of the boronitriding shows saw tooth features and the interface with the substrate that comprising three different regions and is shown in Figure 1b. i) mixture phases of nitride and boride, ii) diffusion zone and iii) the substrate iron. The boronitriding processes leads a mixture of different phases, such as ε-Fe_3N, FeB and Fe_2B and DZ. A total mixture phases thickness of 18.23±12.8 µm and DZ of 34.26 ±4.8 µm.

As a result of the first process in Figure 2 shows the XRD patterns for H13 steel borided, the presence of phases FeB and Fe_2B were confirmed, as well as the presence of CrB and Cr_2B were identified, due to Cr content in the steel. In the second process, the nucleation of nitrides in columns of borides allows the formation of Fe_3N, however, the constant saturation of nitrogen atoms reduces the FeB and Fe_2B layer, and the elimination of the CrB and Cr_2B phases, thus a hard layer with sawn morphology and diffusion zone was obtained by boronitriding process, resulted from XRD confirm the presence of phases type Fe_3N, FeB and Fe_2B as show in Figure 2, also on the top surface was observed porosity. The porosity enhances the adhesion of sealants to the steel surface and improves their behavior in corrosion phenomena

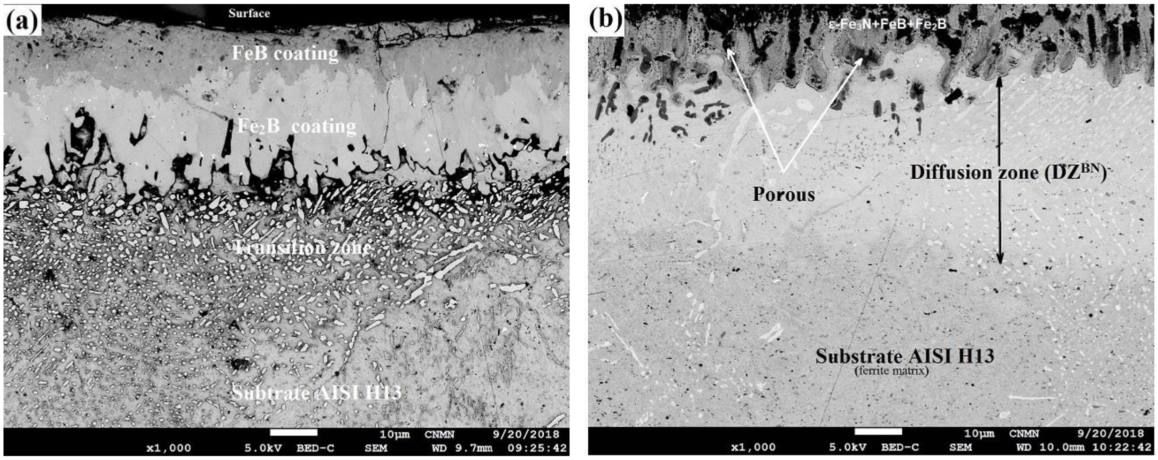

Figure 1. Cross-section micrograph on surface AISI H13 at condition of a) boride and b) boronitride

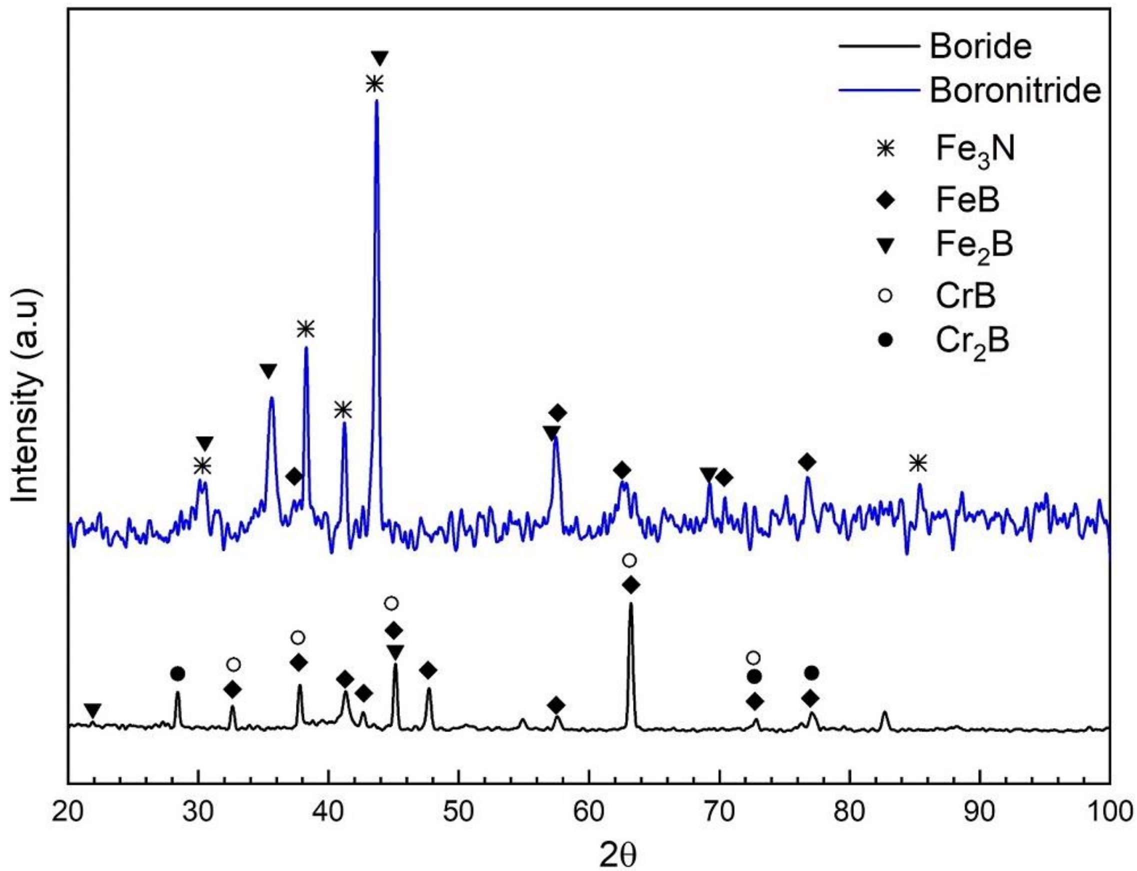

Figure 2. XRD pattern obtained on AISI H13 steel boride and boronitride References

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