

Analysis Microstructural on Gray Cast Iron Boriding and Hydrogen of Permeation

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The need nuclear engineering is to improve the characteristics of ferrous and non-ferrous materials by innovation of layers resistant to hydrogen irradiation, permeation and embrittlement [1-2]. Also the need for resistant layers with the interaction of hydrogen are of interest for industries petroleum, naval, automotive and agriculture, which need innovative materials with layers to mitigate the effect of hydrogen [3-4]. The results presented the properties microstructural of surface and Mechanical, can assist in the selection and design for hydrogen mitigation in the nuclear engineering, manufacturing engineering and product engineering.

We have described the growths of formed layers FeB/Fe₂B and the influence layers FeB/Fe₂B on permeation of hydrogen. The material for this study is a gray cast iron, composition 5.40% C, 1.378% Si, 0.630% Mn, 0.1646% Cr, 0.050% Mo, 0.3662% Cu; dimensions 3.8 mm long, 5 mm wide and 3 mm thick; with a notch at 45°. The formation microstructural of surface on gray cast by boron paste dehydrated at temperature of 1193 K for 8 hours exposure time. The microstructure of surface layers after boriding it was studied using; Scanning Electron Microscope and Energy Dispersive Spectroscopy (EDS-MEB to 100 kV- JEOL 6063 L), Optical Microscopy Olympus (GX 51) and determination of the present layers, XRD analysis was performed on the Cu K α -hardened parts and a λ 1.54 Å (Bruker D8 Advance). The evaluation hardness using an Ultra Micro Hardness Tester Mitutoyo; indentation loads to 200 mN. Hydrogen was produced in the charge cell via a galvanostatic method with a current density of 50mA·cm² and the solution consisted of 0.5M sulfuric acid (H₂SO₄) dissolved in double distilled water added with five drops of carbon disulphide (CS₂); time of 6 hours of hydrogen loading. The evaluation mechanical using Instron model 8502, velocity of advance 0.102 mm/min. The Figure 1a revealed the growth of microstructural of layers FeB/Fe₂B, and sawn morphology layers. EDS-SEM micrographs revealed the presence FeB./Fe₂B as observed Figure 1b with layers to 105 ± 12.9 μ m. The Figure 2 shows the existence FeB, Fe₂B, CrB and SiB₆, result of XRD pattern on a range from 20° to 100°. The hardness results are 1887 to 1969 (Hv) and the elastic modulus results are 268-271 (GPa). Table 1 shows effect of Hydrogen permeation on the gray cast iron boriding. This process of boron dehydrated paste presents the analysis microstructural of the layers FeB/Fe₂B resistance for mitigation hydrogen.

References:

- [1] P Korinko, *Microscopy and Microanalysis* **10** (2004), p. 618.
- [2] AV Belyakov et. al., *Surface Engineering and Applied Electrochemistry* **53** (2017), p. 274.
- [3] O Barrera et al., *Journal of Materials Science* **53** (2018), p. 6251.
- [4] J Toribio et al., *Engineering Failure Analysis* **82** (2017), p. 458.

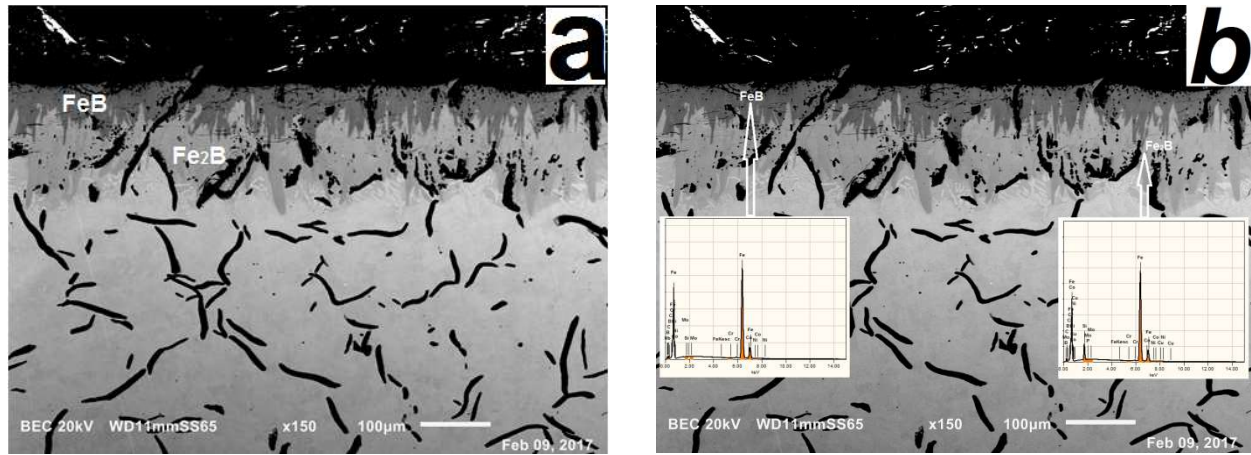


Figure 1. (a) SEM micrographs showing iron borided in the gray cast iron and (b) cross-sectional micrograph and EDS analysis at surface of FeB and Fe₂B by 8 hours of treatment at temperature 1193 K.

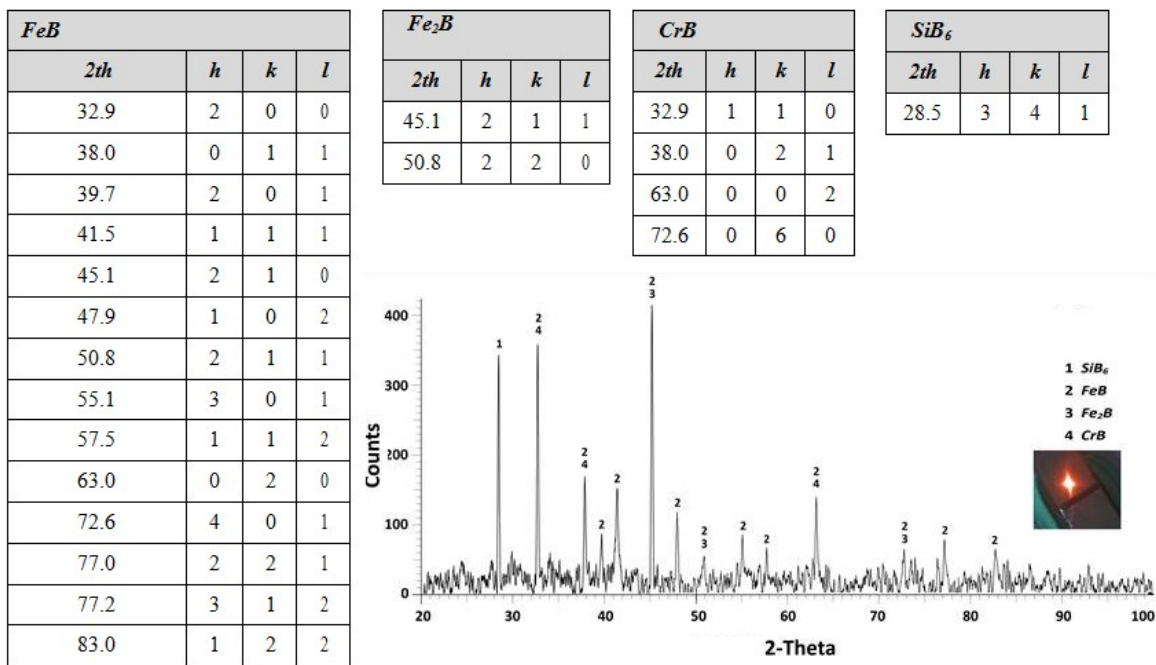


Figure 2. X-ray diffraction patterns obtained by the laser indicate the test site on the gray cast iron borided at 1193 K for 8 hours.

Materials	Conditions (Charged with hydrogen)	Stress (Mpa)	Strain (%)
Cast iron Gray	Without Boriding	42.36	0.379
Cast iron Gray	Boriding 1193K, with 8 h.	153.08	0.590

Table 1. Effect of Hydrogen permeation on el cast iron gray borided