Characterization of oxide layers grown on a Fe-15%Si alloy after cyclic oxidation at 800°C

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This work aims to characterize the oxide layer grown on an intermetallic Fe-Si alloy after cyclic oxidation. This alloy was studied due to its high corrosion resistance and the cost atractiveness when compared to stainless steels [1]. The nominal chemical composition (wt%) was Fe-14.5%Si-0.75%C-4%Cr-0.4Mn-0.35%Cu-0.3%Mo. Cyclic oxidation test was performed during approximately 1,200 hours at 800°C degrees. Fe-Si samples (oxidized and as cast conditions) were characterized by different tecniques: optical microscopy (OM), Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray Spectroscopy (EDS) and X-ray diffraction (XRD).

Results revealed the morphology and composition of the oxide layers. XRD results showed the Fe_3Si phase in the base material. OM and SEM confirmed the presence of a Cu-rich phase (Fig.1), and a spinel structure in the surface (Fig.2). The Cu-rich phase was developed probably due to selective oxidation and small solubility of the Cu in the material base. EDS maps and spectrums revealed the presence of high amount of Cu, Mn and Cr in the oxide layer. Smaller amounts of Al and Fe were also observed; Al was concentrated at the metal oxide interface and Fe was dispersed within the whole oxide scale. The spinel oxides ($A^{2+}B_2^{3+}O_4^{2-}$) usually do not present a exact stoichiometry so making extremely difficult its determination by XRD. Nevertheless, the combination of both characterization techniques, EDS and XRD show the oxides expected to be as $Mn_{3-x}Cu_{x-y}Cr_yO_4$ and $Mn_{2-x}Cu_{1+x}O_4$.

Keywords: Fe-Si alloy, oxide characterization, spinel, SEM, XRD.

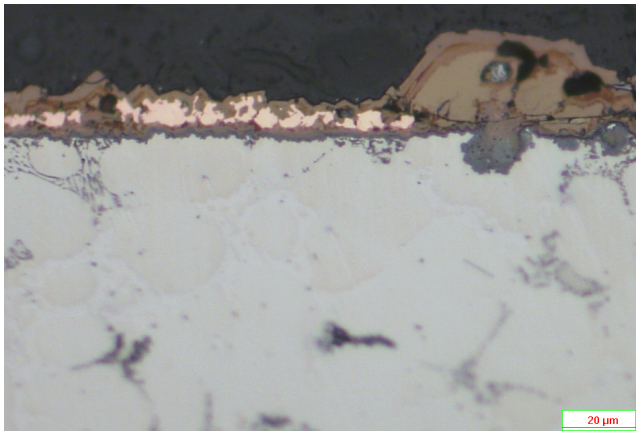

Fig. 1 - Cu-rich phase and oxide layer by OM

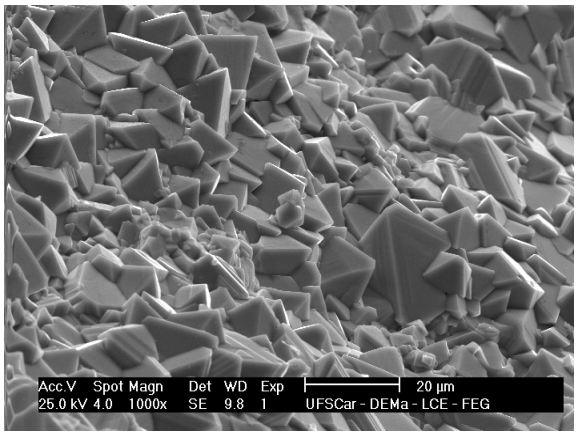

Fig.2 - oxide spinel observation by SEM

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