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GROWTH STRESSES IN NANOSTRUCTURED OXIDE SCALES FORMING ON IRON ALUMINIDES STUDIED BY IN-SITU ENERGY-DISPERSIVE SYNCHROTRON XRD

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Abstract

Iron Alumindes rely upon the formation of an alpha-alumina scale that protects the metal substrate. The oxidation resistance is affected by internal stresses due to growth incompatibilities intrinsic to the oxidation process. At low temperatures, less-protective metastable aluminas may be formed. Transition Al2O3 also modifies the stress state in the oxide layer, since the transformation into alpha-Al2O3 is accompanied by a volume contraction. The aim of this work was to investigate the relation between oxide phase composition during the early oxidation and the growth stresses within the layer. To this end, Fe-15at.%Al polycrystals and single crystals were oxidized at 700oC. The evolution of phase, texture and growth stresses was determined using synchrotron x-ray diffraction. The results show that theta-alumina exists only during the first minutes of oxidation and that the growth stresses are governed by the epitaxy between alumina and hematite and the texture of the oxides.

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