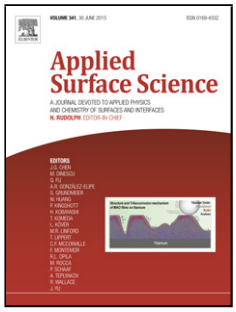

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Beneficial effect of shot peening on steamside oxidation of 300-series austenitic steels: an electrochemical study

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Highlights:

- Oxides with direct contact to oxidative environment exhibits better protective properties (lower CC density)
- Inner topotactic layer does not prevent further oxidation of a steel matrix, due to higher concentration of CC
- The absence of P-type behaviour on Super 304H's oxide suggests formation of Cr_2O_3 layer, with low density of Cr^{3+} vacancies, which sufficiently mitigates the oxidation.
- Steels with similar chemical composition do not result in similar oxidation rate in steam.
- Surface treatment and microstructure is the decisive factor ensuring slower oxidation rate, extending the life of component.

Abstract

The formation of a protective oxide ensures the good corrosion resistance of austenitic steels in high temperature steam. However after long-term interaction even the protective oxide may tend to exfoliate and cause operational problems. With shot peening believed to be an effective method for mitigating steamside oxidation and exfoliation, we compared oxide layers formed on two materials: AISI 316H with a rugged untreated surface and Super304H with a shot-peened surface. In addition to conventional methods (SEM/EDS, Raman spectroscopy), Mott-Schottky analysis was used to characterize the oxide layers in order to determine the quality of the protective oxide. The oxides formed on Super 304H showed unexpected semiconducting behaviour with a significantly lower charge carrier density, thereby supporting the benefits of shot peening. Our findings extend the knowledge applicable to the design of more efficient coal-fired power plants.