UNIVERSITI TEKNOLOGI MARA

CHARACTERIZATION OF SURFACE LAYER DEVELOPMENT ON DUPLEX STAINLESS STEEL RESULTING FROM THERMOCHEMICAL HYBRID TREATMENT

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ABSTRACT

The application of duplex stainless steels in various applications such as in petrochemical, water desalination and paper milling industries has rapidly increased in recent years, taking advantage of the combination of high strength and good corrosion resistance from the dual phase stainless steels. However, having low wear resistance and low surface hardness limits the applicability of the steels for wider applications; thus, improvement of the features is essential. A thermochemical hybrid treatment process has been developed to improve the wear resistance and surface hardness of duplex stainless steels without compromising its corrosion resistance. The process was performed by using a mixture of methane (CH4), ammonia(NH3) and nitrogen (N2) at low temperature of below 500°C. The process simultaneously introduces the alloying elements of carbon and nitrogen into the surface of the duplex stainless steels forming a precipitation free layer along with improvement of wear resistance and surface hardness. This study discusses the influence of the process parameters such as temperature, holding time and gas composition used during the process towards the structural development and morphology of the layer as well as the effects of precipitation on the chromium element. It was found that the nitrogen and carbon diffused at the layer producing expanded austenite phase and expanded ferrite phase of a complex combination of YN, YC, *an* and a<> The expanded phases increased the surface hardness up to five times, improvised the wear resistance of the treated samples. However, traces of precipitation of chromium were detected in sample treated at prolonged 30 hours of holding time and for the sample treated for a temperature of 500 °C, indicating the limit of the process parameter used to produce the precipitation free expanded phases. It can be concluded that the improvement on the surface hardness and wear resistance of duplex stainless steel can be achieved by the formation of expanded phases at the layer by controlling the main parameters during the thermochemical process.

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