UNIVERSITI TEKNOLOGI MARA

THE STUDY OF STRUCTURAL DEVELOPMENT OF EXPANDED AUSTENITE ON DUPLEX STAINLESS STEEL BY LOW TEMPERATURE THERMOCHEMICAL NITRIDING PROCESS

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Thesis submitted in fulfillment
of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of University Technology MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I , hereby, acknowledge that have been supplied with the Acedemic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This research project describes the study of gaseous thermochemical treatment of nitriding duplex stainless steel (DSS) by using a tube furnace. DSS is widely used in various industries such as petrochemical, chemical processing plant and others. However, this material experiences wear and hardness failure during service. Therefore, new development of low temperature nitriding has been introduced to improve the surface properties of this material. The improvement of wear properties and hardness relies on the development of a hard layer on the surface. The nitriding was performed in a temperature range between 400°C, 450°C and 500°C for 6 and 14 hours. The gas composition used for this study was 50% NH_3 + 50% N_2 and 25% NH_3 + 75% N_2. The structural development was characterised using microhardness, X-ray diffraction (XRD), optical microscope, scanning electron microscopy (SEM) and wear resistance test. Based on this study, at a constant temperature of 450°C with 50% NH_3 had produced highest thickness for expanded austenite with 13.96 μm for 6 hours treatment and increased to 76.17 μm for 14 hours treatment. This also led to a significant increase on top surface hardness about 666.3 HV and 962.59 HV for 6 and 14 hours treatment, respectively. For XRD analysis, it clearly shows that Bragg reflections (peaks) for nitrided samples are slightly shifted to lower 2θ angles compared to untreated sample due to formation of expanded austenite. However, increased treatment temperature to 500°C with 25% and 50% ammonia can lead to the formation of chromium nitride precipitates in the nitrogen enriched layer, and thus deteriorate the corrosion resistance of material. It is hope that the study can contribute to the improvement of surface engineering technology of this material for wide range application purposes.

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