Seminar

Institute for Plasma Research

Title : Influence of Structure of Stainless Steels on Plasma Nitriding and Nitrocarburizing for Improving Hardness and Corrosion Resistance

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Time : 04.00 PM

Venue : Seminar Hall, IPR

Abstract:

Stainless steels play vital role as materials of construction for many industrial applications where corrosion resistance is an essential requirement. However, low hardness and the consequent poor wear resistance of these steels have hindered their use in applications also needing good tribological properties (Mesa et al. 2010, Assmann et al. 2011 and Luo et al. 2013). Many conventional thermochemical diffusion treatments have been used to harden these high chromium containing alloys, but at the expense of their corrosion resistance. This is due to the fact that precipitation of chromium nitride (CrN) phases required for enhancing the hardness leads to depletion of Cr from the matrix. Among the thermochemical diffusion techniques, plasma nitriding and nitrocarburizing are considered as emerging technologies for surface modification, for providing high wear resistance combined with corrosion resistance, under optimized process conditions. Under these optimized conditions, the plasma delivers chemically reactive nitrogen species to the substrate surface such that CrN formation is avoided, leading to high surface hardness, retaining or even enhancing good corrosion resistance (Zhao et al. 2005 and Tsujikawa et al. 2005).

Though, plasma nitriding process has been done on most of the stainless steels, not much study has been done on the corrosion behaviour. Further, plasma nitrocarburizing, a technique which is less explored has not been applied to most of the stainless steels. For these reasons, this work is directed towards understanding the plasma nitriding and plasma nitrocarburizing of all the classes of stainless steels and their effect on phase formation, hardness and corrosion resistance. Yet, another aspect that has not been studied is the role of crystal structure on the plasma nitriding and nitrocarburizing behaviour of stainless steels. This is important as there exist different type of stainless steels such as ferritic, austenitic, martensitic, duplex and precipitation hardening stainless steels.

Several techniques such as scanning electron microscope (SEM); wavelength dispersive spectroscope (WDS) and energy dispersive spectroscope (EDS); Glancing incidence x-ray diffractometer (GIXRD); microhardness vickers tester were employed to study the microstructure and thickness of layers, elemental analyses, phases formed and surface hardness respectively. Electrochemical corrosion of plasma nitrided and plasmanitrocarburized stainless steels were studied in 3.5 wt. % NaCl solution using DC polarization and electrochemical impedance.

Plasma nitriding and nitrocarburizing processes improved the surface hardness of all types of stainless steel at all temperatures. Moreover, there was a significant improvement in the pitting corrosion resistance when treated at temperature below 400 °C. Between the two processes the pitting corrosion resistance of all the specimens treated by plasma nitrocarburizing process except for ferritic stainless steels was found to be better.