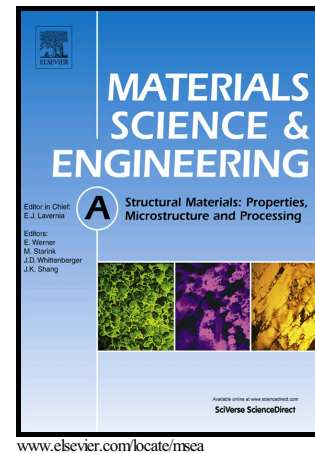


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Influence of simultaneous aging and plasma nitriding on fatigue performance of 17-4 PH stainless steel

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ABSTRACT

This paper investigates fatigue behavior of precipitation hardenable 17-4 PH stainless steel after simultaneous aging and plasma nitriding. For this purpose, “solution treated”, “aged” and “simultaneous aged and nitrided” specimens were compared in terms of hardness, phase analysis, residual stress and fatigue strength. Hardness values of aged specimens were recorded during aging process to find the optimum condition in terms of time and temperature for plasma nitriding at which specimens can be simultaneously nitrided and aged. Plasma nitrided specimens were analyzed for residual stresses, and its effect on mechanical properties including hardness and fatigue strength. The specimens that were plasma nitrided at lower temperatures had the highest core hardness. Increasing the nitriding temperature/time caused an increase in residual stress and, consequently, a higher surface hardness. Both nitriding and aging processes improved fatigue life by more than 40%. Plasma nitriding imparts beneficial effect mainly during high stress fatigue while aging treatment is more effective on low stress fatigue properties. Specimens nitrided at 500 °C for 5 h experienced longer fatigue life for high stress conditions while specimen aged/nitrided at 400 °C for 10 h exhibited the highest fatigue strength.

Keywords: Stainless steel, 17-4 PH, Fatigue strength, Plasma nitriding, Age hardening.

1. Introduction

17-4 PH (AISI Type 630) alloy is the most well-known precipitation hardening martensitic stainless steels with approximately 3-4 wt. % copper content. The small size copper-rich precipitates distributed within the matrix are responsible for increasing the strength of the steel [1-5]. Due to proper combination of mechanical properties and corrosion resistance in 17-4 PH, applications of this alloy have been extended to a variety of marine constructions, chemical industries and critical components in power plants [4-7].

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