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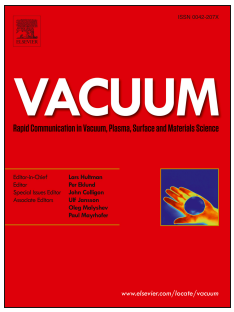

Enhancement of wear resistance of AISI 1045 steel by a two-step plasma treatment

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Enhancement of wear resistance of AISI 1045 steel by a two-step plasma treatment

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Abstract A two-step plasma treatment (TSPT) combining plasma nitrocarburizing (PNC) and plasma nitriding (PN) was developed for AISI 1045 steel, and also compared with PNC-only and PN-only treatment. The microstructure and related properties were investigated by means of scanning electron microscopy (SEM), X-ray diffraction (XRD), Vickers hardness tester and pin-on-disk tribotester. The results showed that TSPT treated specimens exhibited highest surface hardness, lowest friction coefficient of 0.35, decreased 37.5% and 18.6% comparing with PN and PNC, and lowest wear rate of $3.34\times10^{-5}mm^3\cdot Nm^{-1}$, decreased 75.4% and 55.7% comparing with PN and PNC. In other words, TSPT treatment could bring out significant enhancement of wear resistance, which is more than 4 times better than that of PN and more than double than that of PNC, due to the increased compound layer thickness, optimized phase constituents and decreased friction coefficient.

Keywords Plasma nitrocarburizing, AISI 1045 steel, Plasma nitriding, Surface hardness, Wear resistance

1 Introduction

In order to enlarge the applications of metal materials and meet the needs in various service environments, surface modification is essential to improve their fatigue strength, wear and corrosion resistance [1-3]. A majority of surface-modification techniques used for metal materials are based on a variety of chemical reactions that produce optimized structures and properties so as to improve the performance of the materials [4]. Among the existed surface-modification techniques, nitriding treatment is one of the most widely used techniques [5-7]. Unfortunately, the existing plasma nitriding (PN) generally takes dozens of hours or even longer duration to get the

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