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Abstract

In this work, a duplex cathodic cage plasma nitriding (CCPN) process is performed using aluminum (pre and post treatment) and stainless steel cathodic cages. The duplex treated samples are also compared with the single treatments. The nitrided samples are analyzed with Vickers micro-hardness tester, X-ray diffraction and scanning electron microscope along with energy dispersive spectroscopy. It is found that the duplex post-aluminum CC process attains a surface hardness of ~ 1124 HV; far higher than the other treated samples and previously reported in the literature. The crystal structure of post-aluminum nitrided samples shows the dominant aluminum nitride phase. The compatibility of the reported process with the existing industrial systems makes it promising for large-scale industrial uses.

1. Introduction

The non-alloyed steels are less expensive and are applicable in vast areas of interest, including automobile components. Unfortunately, the mechanical features including surface hardness are not outstanding, and their use is restricted in certain applications [1, 2]. Because of low hardness, they show little resistance to scratching and abrasive wear behavior. The plasma nitriding is believed to be an effective approach to enhance the surface properties of various materials including steel [3-5]. Nonetheless, non-alloyed steels are not suitable for plasma treatment. It happens due to in-depth nitrogen diffusion and iron nitrides are consequently established at greater depths instead of surfaces [2].

It is reported that nitriding of alloyed En40B and non-alloyed steels Ck45 (having similar bulk hardness) under identical conditions gives out the surface hardness of 900 HV and 470 HV respectively [6]. Such non-alloyed steels can be nitrided by introducing interlayer or