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M. Naeem, M. Zaka-ul-Islam, M. Shafiq, M. I. Bashir, J. C. Díaz-Guillén, M. Zakaullah

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M. Naeem [1], M. Zaka-ul-Islam [2], M. Shafiq [1], M. I. Bashir [1], J. C. Díaz-Guillén [3], M. Zakaullah[1,*]

[1]Department of Physics, Quaid-i-Azam University, 45320 Islamabad, Pakistan

[2]Department of Physics, Faculty of Science, Jazan University, Jazan, 45142, Kingdom of Saudi Arabia

[3]CONACYT Research Fellow, Mexican Corporation for Materials Research, Saltillo, Coahuila Mexico

*Corresponding author. Tel.: +92 5190642069; Fax: +92 5190642240

E-mail address: mzakaullah@qau.edu.pk (M. Zakaullah)

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Abstract

Cathodic cage plasma nitriding (CCPN) is an advanced technique for the enhancement of the surface chemical and mechanical properties of steels. In this process, the cathodic cage (CC) is of central importance since it influences the temperature distribution over the specimen as well as the electrons generation and their confinement. The diameter of the CC is usually arbitrarily chosen, and its influence on nitriding performance has not been investigated systematically. In this report, we have investigated the influence of the CC diameter on the surface properties of nitrided AISI 304 specimens. The specimens are processed using various diameters of CC (13-21 cm), at fixed substrate temperature, pressure, and treatment time. It is observed that the CC diameter is an important parameter, and it influences the plasma kinetics as well as the surface characteristics of treated samples. The reduction of the CC diameter changes the crystalline phases from expanded austenite (S) to iron nitrides $Fe_{2-3}N, Fe_4N$, (without chromium nitrides precipitates), while the surface hardness, wear resistance and corrosion resistance are significantly improved. The results also show a positive correlation with optical emission from the plasma and SRIM simulation. This study clarifies the role of the CC diameter on mechanical, corrosion and tribological properties of austenite steels.

1. Introduction

Plasma nitriding is a surface modification technique which is extensively used for the enhancement of mechanical as well as corrosion properties of various materials. It is advantageous over gas and salt bath nitriding techniques, but it also exhibits certain