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# The effect of argon admixing on nitriding of plain carbon steel in $N_2$ and $N_2$-$H_2$ plasma

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## Abstract

The aim of this study is to assess the effect of argon gas (0-30 %) addition in pure nitrogen and nitrogen-hydrogen admixture on the surface properties of plain carbon steel by cathodic cage plasma nitriding. The surface hardness is obtained using hardness tester, phase composition is evaluated by X-ray diffraction, surface features are observed using scanning electron microscope (SEM) along with energy-dispersive X-ray spectroscopy (EDS) and wear rate is assessed using the ball-on-disc tester. Insignificant change in hardness is found in nitrogen plasma (with or without argon admixing), whereas it is expressively improved in nitrogen-hydrogen mixture plasma. The samples treated in nitrogen atmosphere mainly contains oxides, whereas iron nitrides in the nitrogen-hydrogen atmosphere, both with and without argon. The thickness of the modified layer is drastically changed with gasses composition, and the thick layer is achieved in nitrogen-hydrogen admixture. The wear rate is also significantly improved while using nitrogen-hydrogen mixture, and best results are achieved by using 20 % argon in this mixture. This study reveals that although argon addition can enhance the reactive species production, however the presence of hydrogen is compulsory to improve the surface properties.