World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:16, No:12, 2022

Surface Engineering and Characterization of S-Phase Formed in AISI 304 By Low-Temperature Nitrocarburizing

Authors : Jeet Vijay Sah, Alphonsa Joseph, Pravin Kumari Dwivedi, Ghanshyam Jhala, Subroto Mukherjee

Abstract : AISI 304 is known for its corrosion resistance which comes from Cr that forms passive Cr_2O_3 on the surface. But its poor hardness makes it unsuitable for applications where the steel also requires high wear resistance. This can be improved by surface hardening using nitrocarburizing processes, which form ε-Fe2-3N, γ'-Fe4N, nitrides, and carbides of Cr and Fe on the surface and subsurface. These formed phases give the surface greater hardness, but the corrosion resistance drops because of the lack of Cr2O3 passivation as a result. To overcome this problem, plasma nitrocarburizing processes are being developed where the process temperatures are kept below 723 K to avoid Cr-N precipitation. In the presented work, low-temperature pulsed-DC plasma nitrocarburizing utilizing a discharge of N_2-H_2-C_2H_2 at 500 Pa with varying N_2:H_2 ratios was conducted on AISI 304 samples at 673 K. The process durations were also varied, and the samples were characterized by microindentation using Vicker's hardness tester, corrosion resistances were established from electrochemical impedance studies, and corrosion potentials and corrosion currents were obtained by potentiodynamic polarization testing. XRD revealed S-phase, which is a supersaturated solid solution of N and C in the γ phase. The S-phase was observed to be composed of the expanded phases of γ; γN, γC, and γ'N and ε'N phases. Significant improvement in surface hardness was achieved after every process, which is attributed to the S-phase. Corrosion resistance was also found to improve after the processes. The samples were also characterized by XPS, SEM, and GDOES.

Keywords : AISI 304, surface engineering, nitrocarburizing, S-phase
Conference Title : ICMSN 2022 : International Conference on Materials Science and Nanotechnology
Conference Location : London, United Kingdom
Conference Dates : December 09-10, 2022