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Interaction between carbon and nitrogen during plasma assisted nitrocarburizing and sequential nitriding and carburizing treatments of austenitic stainless steel

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Low temperature plasma assisted nitriding (PAN), carburizing (PAC) and nitrocarburizing (PANC) are now well established surface treatments to improve the tribological properties of austenitic stainless steels. Below 420°C for PAN and below 500°C for PAC, such treatments produce the so called expanded austenite (with nitrogen for PAN or with carbon for PAC). The implementation of PAN, PAC and PANC processes was presented earlier, but it is important to report that the amount of interstitials incorporated in stainless steel is strongly dependent on the type of process. So, the nitrogen content that can be found in nitrided or nitrocarburized layers range from 14 to 35 at%, whereas the amount of incorporated carbon in carburized or nitrocarburized layers range from 0 to 12 at%. During nitrocarburizing, the repulsive effect that nitrogen exerts on carbon generally produces two separated layers with a defined interface. The soft interstitial content gradient nitrocarburized layers can be exploited for industrial purpose. However, in spite of its practical interest, very few is known on the interaction of carbon and nitrogen during a nitrocarburizing treatment. The purpose of this communication is to present some results obtained by PANC and by sequential treatments: carburizing followed by nitriding and nitriding followed by carburizing. We perform PAN, PAC and PANC treatments by multi-dipolar plasma based on the Distributed Electron Cyclotron Resonance concept. The amount of nitrogen and carbon content incorporated into the stainless steel substrate are measured by glow discharge optical spectroscopy. The thicknesses of the different layers are measured by cross-sectional views. By doing so, we are able to compare the amount of incorporated interstitials during PANC and sequential PAN and PAC treatments. It appears that the amount of carbon incorporated during a PANC treatment is much less than the one incorporated during an equivalent sequential treatment PAC followed by PAN.

Keywords

Nitriding

Carburizing

carbonitriding

stainless steel