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Plasma nitriding of quenched and tempered ductile cast iron without compound layer formation

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Abstract – A ductile cast iron (3.75C-2.54Si-0.16Mn-0.068P) was plasma nitrided after quenching and tempering, aiming the improvement of hardness obtaining a complete diffusion layer, without the compound layer formation. The plasma nitriding was carried out with different compositions and the same temperature and time. It was verified that for lower N_2 quantities, there was a deeper diffusion layer.

Nitriding is a common method for improving the hardness and the mechanical properties, wear and corrosion resistance of metals. Many machine parts, work pieces (toothwheels, camshafts, cylinder liners, rocker arms) are industrially nitrided in order to improve their tribological and chemical properties [1]. The compound layer formation during nitriding is desired when the component is submitted to sliding and hard particles wear. In the other hand, in situations involving cyclic solicitations, the compound layer suppression - obtaining only diffusion layer, is more adequated [2]. The aim of this paper is to investigate plasma nitriding conditions of quenched and tempered ductile cast iron resulting in diffusion layer only.

The material was a ductile cast iron (3.75C-2.54Si-0.16Mn-0.068P). It was austenitized at 900ºC for 1 hour, and oil quenched. Later it was tempered at 200 ºC for 2 hours. The matrix hardness value obtained with this treatment was 620 HV_{30}. The plasma nitriding was carried out following the conditions presented in Table 1. The samples were characterized using optical microscopy and Vickers hardness.

It was not verified compound layer formation in the 10% N_2 nitriding condition samples, comparing to the 15% N_2 nitriding condition ones. The hardness for deeper depths is higher for the 10% N_2 nitriding conditions samples, indicating a deeper diffusion layer. In the other hand the diffusion of N_2 is difficulted by the compound layer formation in the 15% N_2 nitriding condition, justifying the hardness values observed to deeper depths for this condition.

Table 1: Nitriding conditions.

Nitriding Atmosphere [%]			Nitriding time [h]	Working Pressure [torr]	Temperature [ºC]
N2	H2	Ar			
10	72	18	8	4	450
15	68	17	8		

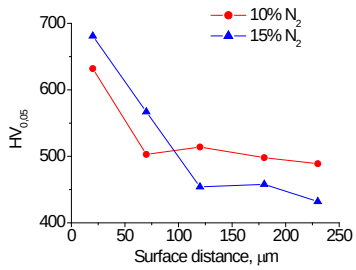

Figure 1: Microhardness profile for 10% N_2 and 15% N_2 nitriding conditions.

References

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