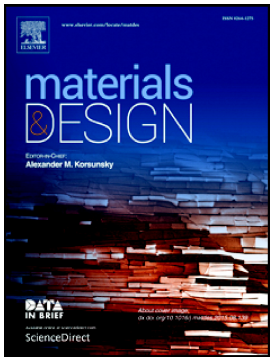

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Structure refinement of high-Cr cast iron by plasma surface melting and post-heat treatment

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Abstract

Plasma transferred arc technique was used for the surface modification of 14.5wt%-Cr cast iron. The objective of this work was to investigate the microstructural and hardness changes, caused by plasma surface melting and post heat treatment. The processing parameters were: arc current 250 A, voltage 60 V, working gas – argon, scanning speed: 0.25 m/min which ensured the surface temperature about 1500 ^{o}C. The study involved optical microscopy, SEM/EDS, XRD, Finite element modeling (FEM), Thermo-Calc calculations and microhardness measurements. A modified melted layer of about 230 μm depth was obtained comprising 10-fold refined dendrites and eutectic carbides as compared with conventional casting. The as plasma treated layer contained supersaturated austenite and "fresh" eutectic "austenite+M_7C_3" crystallized after melting. The latter formed fine networks or "massive" areas comprising fine carbide plates and fibers. A shell/core structure in coarse dendrites was revealed with different contents of Cr and secondary carbides. Post-heat treatment (isothermal holding at 800 ^{o}C for 2 h followed by oil quenching) resulted in precipitation of nano-sized secondary carbides in austenite followed by martensite transformation, which significantly increased the microhardness of the melted layer. Phase transformation phenomena and sequences are discussed based on Finite Element/Thermo-Calc modeling, EDS-investigation and hardness profile results.

Key words: high-chromium cast iron, plasma melting, post-heat treatment, structure refinement, carbides, matrix.

1. Introduction

High-chromium white cast irons (HCCI) belong to a family of high-alloy cast irons, which are applied where high wear resistance is essential [1, 2]. Actually, these materials may be considered as composites since they contain a considerable volume fraction of chromium carbides embedded in the