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Influence of Alloying Elements on High Temperature Hardness of M_7C_3 Carbide in High Chromium White Iron

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Abstract. In this study, the influences of Mo and W addition on the high temperature hardness of a chromium carbide, M_7C_3 type, were investigated using unidirectional solidified hypereutectic 25mass%Cr cast iron. Concentrations of alloying elements in primary M_7C_3 carbide were measured by EDS. The amount of Mo and W in the carbide increased and that of Fe decreased with an increase in the both elements of the cast iron. However, Cr content was about 60 mass% and it was almost the same in spite of increasing the Mo and W contents in the cast iron. It was found from the measurement results by XRD that the lattice constant of M_7C_3 carbide changed and the volume of a unit cell increased lineally as the Mo and W content was increased. From this reason, it can be considered that Fe atoms in M_7C_3 carbide were substituted by Mo or W which has larger atomic radius than Fe. In all the specimens, the hardness of M_7C_3 carbides are about 1600HV0.3 at the room temperature, and it decreases gradually with a rise of the test temperature. The decreasing ratio of carbide hardness in the cast iron with Mo or W is small at high temperature range in comparison with that in the alloy-free cast iron. The decreasing ration in the high temperature hardness is changed by increasing the amount of Mo or W in the M_7C_3 carbide. Therefore, it can be said that the dissolution of Mo or W atom into M_7C_3 carbide is very effective to decrease the degradation of high temperature hardness. However, as the concentration of both elements in the M_7C_3 carbide exceeds a certain amount, the decreasing ratio of the hardness gets smaller. As a result, it is considered that there exists a limit of the alloy concentration to strengthen the carbide at high temperature.

Keywords: High Cr cast iron, M_7C_3 carbide, high temperature, hardness, alloying element, wear.