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Effects of chromium and carbon content on microstructure and properties of TiC-steel composites

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Abstract: The composite of low alloy steel reinforced with TiC particles (36 wt.%) was prepared by the powder metallurgy (PM) process in this paper. The effects of the chromium content and the total carbon content on the composites were studied. The scanning electron microscopy (SEM) was used to observe the microstructure and such properties as porosity, hardness, transverse rupture strength (TRS) and fracture morphology of the samples were tested. The results show that the optimum sintering temperature decreases with the increase of chromium content. The porosity of sintered samples decreases with increasing the total carbon content, and increases with increasing the chromium content. The TRS and hardness of samples increase with the increase of the carbon content. With the increase of the chromium content, the TRS of the sample gradually decreases, and the hardness firstly increases and then decreases a little. This results from the combined effects of the martensite amount and the shape, size and composition of precipitated chromium carbides in the steel matrix.

Key Words: Metal matrix composite; Titanium carbide; Chromium; Carbon; Cermet

1. Introduction

Titanium carbide reinforced steel matrix composite is made up of steel with good plasticity, good strength and titanium carbide imparting enhanced hardness to the composite as a whole. In addition, the composite has a wide range of technical characteristics, such as machinability, heat-treatability and forgeability. Many researchers have been involved its research since it had been developed[1-3].

As the composite contains more steel matrix, study on the steel matrix showed that the composition of the steel matrix has important effects on the microstructure and comprehensive mechanical properties of the composite. The composite has different mechanical properties with different matrix under different conditions[4,5]. Li et al[6] prepared in-situ TiC particles (>50 wt.%) reinforced Fe-based composite by the combination of in-situ synthesis and spark plasma sintering of ferrotitanium and carbon black powders, and the maximum relative density and hardness of the composite are 99.2% and 83.2 HRA, respectively. AlMangour et al[7] reported in-situ