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Preparation, microstructure, and properties of tungsten alloys reinforced by ZrO₂ particles

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Abstract

Tungsten alloys reinforced by in-situ tetragonal zirconia (W–ZrO₂) were developed via the azeotropic distillation method combined with the powder metallurgy method. The microstructure and abrasive wear properties were studied. The in-situ ZrO₂ particles in the tungsten matrix were obtained by the decomposition of zirconium nitrate after liquid–liquid incorporation of (NH₄)₆H₂W₁₂O₄₀ and Zr(NO₃)₄ aqueous solution. The ZrO₂ particles were distributed evenly in the tungsten matrix, which refined tungsten powders and the grains of tungsten alloys significantly. The density and Vickers hardness of the tungsten alloys decreased with increasing ZrO₂ mass fraction. However, the wear resistance increased firstly and then decreased with increasing ZrO₂ mass fraction. The optimal amount of ZrO₂ for improving wear property is 3%, with the wear resistance of W–3% ZrO₂ improving by approximately 20%–40% compared with that of pure tungsten. The proper amount of ZrO₂ particles can efficiently prevent microcutting to protect the tungsten matrix, thereby enhancing the wear resistance of tungsten alloys.

Keywords: Tungsten alloy; Zirconia; Azeotropic distillation; Wear resistance

1. Introduction

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