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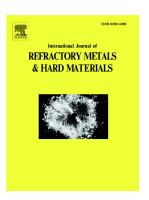
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ACCEPTED MANUSCRIPT

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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