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Microstructure and mechanical property of a novel ReMoTaW high-entropy alloy with high density

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Abstract: This work focuses on a novel high-entropy alloy, ReMoTaW, with high density of 16.69 × 10^3 kg/m^3. The high-entropy alloy displays three disordered solid solution phases. The phase segregation is explained by binary alloy phase diagrams and melting point temperature differences during non-equilibrium solidification. The maximum strength, failure strain and hardness are, respectively, 1451 MPa, 5.69% and 640 HV.

Keywords: High-entropy alloys; Microstructure; Segregation; Phase diagram; Mechanical properties

1. Introduction

High entropy alloys (HEAs) have opened up a wide range of novel alloy system and they show a series of excellent properties, including high hardness, high strength and other characteristics [1-3]. To date, the mostly widely studied elements for HEAs are 3d transition metals: Al, Co, Cr, Cu, Fe, Mn, Ni, Ti and V. These HEAs are mostly based on CoCrFeNi, such as CoCrFeNiMn and AlCoCrCuFeNi [4]. Another widely studied HEA family contains refractory metals: Cr, Hf, Mo, Nb, Ta, Ti, V, W and Zr, plus Al, and most refractory HEAs are based on HfNbTaZr, NbMoTaW, CrMoNbTa or CrNbVZr element groupings [4-11]. Some HEAs such as NbMoTaW(V) and MoNbHfZrTi exhibited a single-phase solid solution, while others indicated two or more phases such as TiNbTaZrMo and AlMo0.5NbTa0.5TiZr.

Since metallic alloys with high density remain in high demand for advanced science and technology, such as armour piercing projectile, shaped charge liner in ordnance industry and density gradient materials in dynamic high-pressure physics, it is a rationale for developing HEAs consisting

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