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Microstructure and mechanical properties of rhenium prepared by electroforming in NaCl-KCl-CsCl-K_2ReCl_6 molten salts

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Abstract: Rhenium plates of ~250μm thick were prepared by electroforming in NaCl-KCl-CsCl-K_2ReCl_6 molten salts. The as-deposited rhenium has a near-columnar, fiber-like grain structure and a laminar and twin substructure. The tensile strength and fracture elongation of as-deposited rhenium tested at room temperature were 1040 ± 40MPa and 8 ± 1.2%, respectively. After annealing at 1000℃ to 1600℃ for 1 h, the grain configuration changed as follows: near-columnar and fiber-like structure →fine equiaxed grain structure →coarse equiaxed grain structure →coarse equiaxed grain mixed with large columnar grain structure. A better combination of strength (744MPa) and plasticity (18.8%) was obtained by annealing at 1400℃ for 1h. The grain configuration and substructure, residual stress and oxygen content affect rhenium′s mechanical properties with the oxygen content appearing to play a dominant role.

Key words: rhenium; electroforming; molten salt; annealing; mechanical property

1. Introduction

Although the content of rhenium (Re) in the earth′s crust is very small and is estimated to be approx. 10^{-7}%, it is irreplaceable in many industrial applications [1]. Due to its unique structure (with a c/a rate of 1.616) [2], Re has an exclusive combination of properties including high melting point (3180℃), high modulus, high strength and ductility at elevated temperatures, and excellent corrosion resistance [2, 3], which make it extremely attractive in a

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