

Accepted Manuscript

The study on low temperature sintering of Nano-tungsten powders

Chai Ren, Z. Zak Fang, Huan Zhang, Mark Koopman

PII: S0263-4368(16)30215-3
DOI: doi: [10.1016/j.ijrmhm.2016.10.003](https://doi.org/10.1016/j.ijrmhm.2016.10.003)
Reference: RMHM 4339

To appear in: *International Journal of Refractory Metals and Hard Materials*

Received date: 19 April 2016
Revised date: 22 September 2016
Accepted date: 5 October 2016



Please cite this article as: Ren Chai, Fang Z. Zak, Zhang Huan, Koopman Mark, The study on low temperature sintering of Nano-tungsten powders, *International Journal of Refractory Metals and Hard Materials* (2016), doi: [10.1016/j.ijrmhm.2016.10.003](https://doi.org/10.1016/j.ijrmhm.2016.10.003)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The Study on Low Temperature Sintering of Nano-Tungsten Powders

Chai Ren, Z. Zak Fang*, Huan Zhang, Mark Koopman

Department of Metallurgical Engineering, University of Utah, 135 S. 1460 E. Rm 412, Salt Lake City, UT84112, United States

Abstract

Ultrafine grain tungsten is a promising candidate for plasma facing component applications in future fusion reactors. The conventional press-and-sinter powder metallurgy method is a preferred route for producing ultrafine grain tungsten from nanosize tungsten powders. However, controlling grain growth, while simultaneously attempting to achieve maximum densification, has been a challenge for making UGF tungsten by sintering. In this study, the effect of processing parameters on the densification and grain growth of nano-W powders was investigated. Near-fully densified tungsten was obtained at sintering temperatures between 1100 and 1300 °C, and both Ar and H₂ sintering atmospheres were investigated. The Ar sintering atmosphere was determined to more favorably promote densification and minimize grain growth. The nanosized tungsten powder compacts were subjected to reduction in H₂ as a part of the sintering cycle. The reduction temperature was found to have significant effects on the sintering of nano-W powder, primarily as a result of grain coarsening, which was seen at temperatures as low as 700 °C.

Keywords: Nanocrystalline Material, Tungsten, Sintering, Grain Growth, Ultrafine grain

1. Introduction

Tungsten has a number of unique properties that establish it as a candidate material for fusion reactor applications. These properties include high melting point, high thermal conductivity, excellent mechanical properties at elevated temperatures, low tritium retention [1-2], low sputtering yield [3], and high erosion resistance [4]. These properties make tungsten especially promising for divertors and other plasma facing components in experimental fusion reactors, such as the International Thermonuclear Experimental Reactor (ITER) [5-6]. However, tungsten also has several serious deficiencies related to brittleness of the material, including room-temperature brittleness, recrystallization brittleness, and irradiation induced brittleness [7-9], which present risks in fusion reactor applications. The brittleness of tungsten may lead to poor thermal shock resistance when exposed to extremely high cyclic heating. And, additionally, brittleness also makes the material difficult to fabricate into functional components.

The use of nanocrystalline tungsten has been considered one of the approaches that could potentially improve the ductility of tungsten and decrease the ductile-to-brittle-transition-temperature DBTT [10]. The effect of the nanocrystalline structure or ultrafine grain structure on the mechanical behavior of tungsten has been shown by Y. Kitsunai et al. They showed that the DBTT can be reduced to 178.9 °C for W alloys with an average grain size of 0.44 μm [11].

Download English Version:

<https://daneshyari.com/en/article/7989975>

Download Persian Version:

<https://daneshyari.com/article/7989975>

[Daneshyari.com](https://daneshyari.com)