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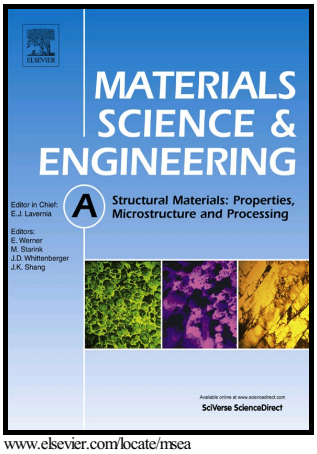

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Determination of the DBTT of nanoscale ZrC doped W alloys through amplitude-dependent internal friction technique

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Abstract

In this paper, 1 mm thick W-0.5wt.%ZrC alloy plates were prepared by mechanical milling, hot pressing sintering and multistep hot and cold rolling. A newly developed testing technique based on the amplitude-dependent internal friction (ADIF) was used to determine the ductile-to-brittle transition temperature (DBTT) of this W-0.5wt%ZrC alloy. The DBTT obtained by ADIF technique is in the range of 50 to 80 °C, which is in consistence with the tensile tests. Qualitative relationship between the critical strain amplitude in ADIF and the yield stress in tensile test was also found. The ADIF technique was confirmed to be an available method to determine the DBTT of the materials. Microstructure analysis indicated that the relative low DBTT and the high strength of the W-0.5wt%ZrC alloy plates were resulted from the multistep hot and cold rolling and nanoscale particle pinning effects.

Keywords

Tungsten (W), ductile-to-brittle transition temperature (DBTT), internal friction, tensile tests

Introduction

Tungsten (W) has the highest melting temperature (~ 3410 °C) among refractory metals. It shows high thermal conductivity [1], low tritium retention [2, 3], low sputtering yield [4], low erosion rate [5, 6] and high neutron load capacity. The combination of these superior properties make it appealing for high temperature applications such as first wall plasma facing components (PFCs) in future nuclear fusion reactors (ITER and DEMO) [1-4]. However, one of the major deterrents for the