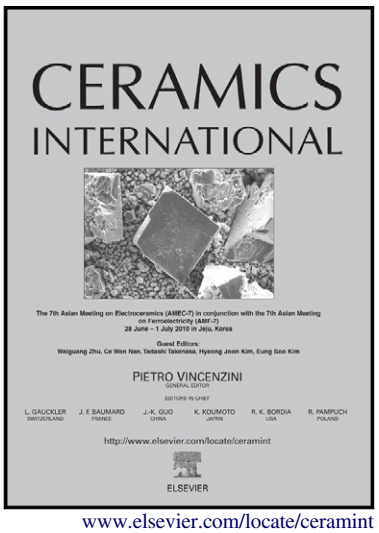

www.elsevier.com/locate/ceramint

Effect of excess boron oxide on the formation of tungsten boride nanocomposites by mechanically induced self-sustaining reaction

Bahman Nasiri-Tabrizi, Reza Ebrahimi-Kahrizsangi, Mojtaba Bahrami-Karkevandi

PII: S0272-8842(14)00885-2
DOI: http://dx.doi.org/10.1016/j.ceramint.2014.06.013
Reference: CERI8698

To appear in: *Ceramics International*

Received date: 11 March 2014
Revised date: 1 June 2014
Accepted date: 3 June 2014

Cite this article as: Bahman Nasiri-Tabrizi, Reza Ebrahimi-Kahrizsangi, Mojtaba Bahrami-Karkevandi, Effect of excess boron oxide on the formation of tungsten boride nanocomposites by mechanically induced self-sustaining reaction, *Ceramics International,* http://dx.doi.org/10.1016/j.ceramint.2014.06.013

Effect of excess boron oxide on the formation of tungsten boride nanocomposites by mechanically induced self-sustaining reaction

Bahman Nasiri-Tabrizi, Reza Ebrahimi-Kahrizsangi*, Mojtaba Bahrami-Karkevandi

Advanced Materials Research Center, Materials Engineering Department, Najafabad Branch, Islamic Azad University, Isfahan, Iran

Abstract

The influence of the type of reducing agent, milling time and excess boron oxide on the formation of tungsten boride nanocomposites by mechanically induced self-sustaining reaction were studied. The powder mixtures were mechanically activated using a high-energy planetary ball mill under two distinct experimental conditions. In the first manner, a mixture of tungsten trioxide, boron oxide and graphite with the stoichiometric composition was milled for different times. In the second approach, a mixture of tungsten trioxide, boron oxide and elemental magnesium with a molar ratio of 2:*x*:*y* (with *x* = 2.5–6.25 and *y* = 13.5–24.75) was activated for 1 and 30 h. In the presence of 30 to 50 wt% excess boron oxide, WB was formed during milling. Further increasing the boron oxide content to 150 wt% led to a significant change in the mechanochemical behavior of the system so that WB and W_2B_5 became more dominant after 1 h of milling. During leaching in 18% HCl aqueous solution, MgO was completely removed and consequently tungsten boride nanocomposites with high phase purity were obtained. According to microscopic observations, the 30 h milled sample showed an average particle size of about 95 nm after the leaching process.

Keywords: WO_3–B_2O_3–X (C, Mg); MSR; Nanocomposite; Thermodynamic assessment; Excess boron oxide.

1. Introduction

Tungsten borides (TBs) have received substantial interest as a distinct class of transition-metal light-element compounds due to their unique features, such as high melting points, high hardness, good electrical and thermal conductivity, chemical inertness, and excellent wear and corrosion resistance [1,2].

In W–B system, the existence of different types of borides like WB, W_2B, W_2B_5, WB_2, WB_4, and WB_{12} have been reported [3]. According to the previous studies, W_2B_5 is a promising reinforcement for carbon-based materials and refractory carbides like B_4C and WC [4,5]. Besides, it has been reported that the addition of WB to MgB_2 enhanced the superconducting properties [6]. On the other hand, in the above mentioned system, the highest boride of tungsten (WB_4)

* Corresponding author. Tel.: +98 3312291111; fax: +98 3312291008
E-mail address: rezaebrahimi@iaun.ac.ir, rezaebrahimiir@yahoo.com (R. Ebrahimi-Kahrizsangi).