

Characterization of Re₂C obtained from different Re:C stoichiometries

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Transition metal carbides are very interesting compounds, with a high melting point, low compressibility, strength and hardness, which make them potential materials for industrial applications [1]. Rhenium carbide (Re₂C) has only been synthesized by high temperature high pressure and mechanochemical methods [2-3]. A cubic phase of rhenium carbide was reported in 1975 [4]; however, all attempts to obtain that phase have been unsuccessful [5-6]. Thus, a systematic study of rhenium carbide synthesis at different rhenium and carbon stoichiometries is vital in order to obtain experimental evidence of the formation of that cubic phase. In this work, we report a study of the synthesis of rhenium carbide from three different Re:C nominal stoichiometries (1:1, 1:2 and 2:1). The materials were prepared by mechanochemical synthesis using WC as milling material. The reactions were monitored by X-ray diffraction (Figure 1). The materials obtained were characterized by scanning electron microscopy (Figure 2) and transmission electron microscopy (Figure 3 and 4). The most prominent results obtained in this study are as follows: (i) Re₂C was obtained from 1:1 and nominal 2:1 stoichiometries, (ii) no evidence of rhenium carbide cubic phase, and (iii) no rhenium carbide phase was obtained for 1:2 nominal stoichiometry.

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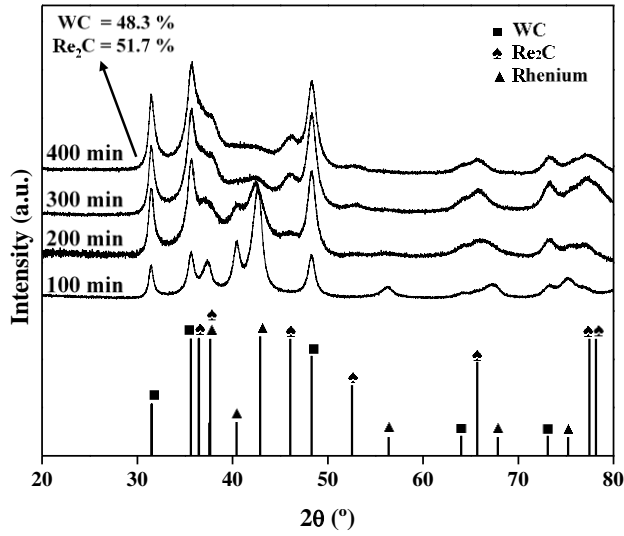


Figure 1. XRD patterns of rhenium carbide synthesis from Re:C 2:1 nominal stoichiometry. Stick plots for rhenium (\blacktriangle , PDF4+ 01-087-0599), tungsten carbide (\blacksquare , 04-007-5192) and rhenium carbide (\blacklozenge , 00-026-1355).

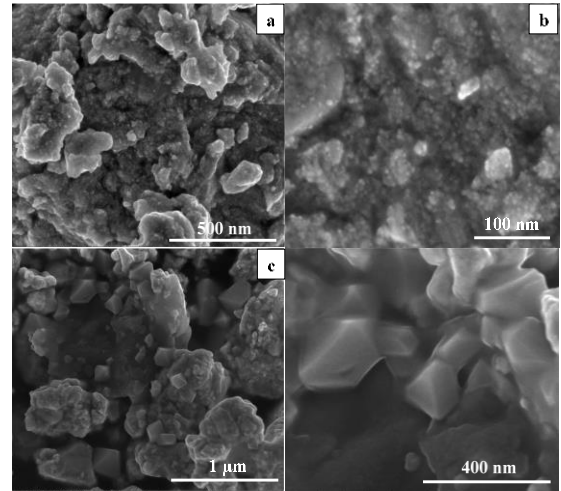


Figure 2. SEM characterization of 400 min milling sample obtained from Re:C 2:1 stoichiometry. Several polyhedral particles can be seen.

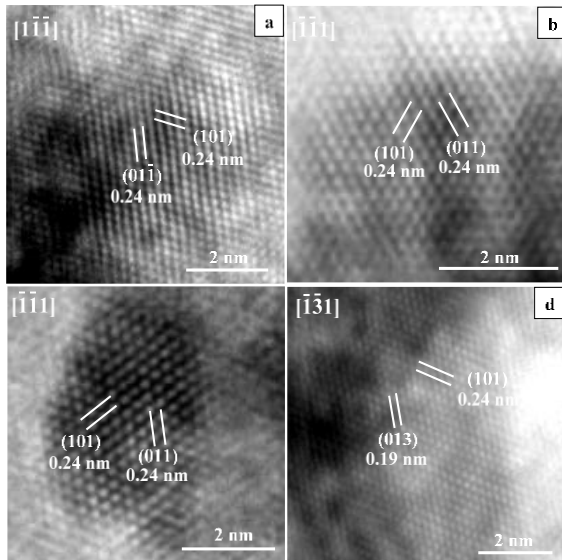


Figure 3. Transmission electron microscopy characterization of 400 min milling sample obtained from Re:C 2:1 stoichiometry, showing crystallographic planes consistent with Re_2C phase.

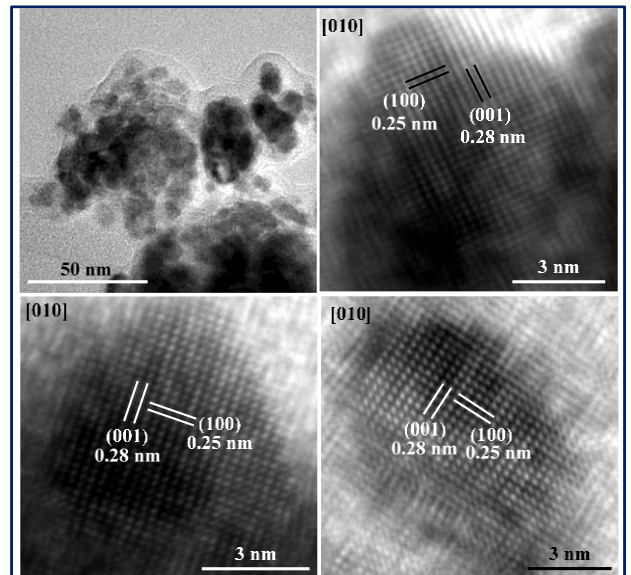


Figure 4. TEM characterization of 2000 min milling sample obtained from Re:C 1:2 stoichiometry, showing crystallographic planes consistent with WC phase.