DOI: 10.1017/S1431927603443158
Microsc Microanal 9(Suppl 2), 2003

ELECTRON MICROSCOPY CHARACTERIZATION OF THE DISPERSION STRENGTHENED COPPER-B_4C ALLOY

M. López, J.A. Jiménez(*), C. Camurri , V. Vergara
Departamento de Ingeniería Metalúrgica, Universidad de Concepción, Casilla 53-C, Concepción, Chile
(*)Centro Nacional de Investigaciones Metalúrgicas (CENIM), Av. G. Del Amo 8-28040, Madrid, España.

Copper – Ceramic alloys, strengthened by dispersion of ceramic materials have been obtained during the last several years trying to find a good combination of electrical conductivity and relatively high hardness and mechanical strength, at moderate temperature, where copper mechanical properties are relatively low especially above 473ºK.
A new strengthened by precipitation copper alloy with 2% volume of B_4C has been investigated using WDX microprobe, scanning and transmission electron microscopy (SEM,TEM).These ceramics as second phase have to present very low solubility in copper, high melting point and low inter-phase energy in order to guarantee the stability of the microstructure during the consolidation process.
In this work, the elaboration of copper alloy with 2% volume of B_4C was carried out in two stages: mechanical alloying (MA) in a planetary mill of high energy during 15 h under argon atmosphere and consolidation by hot isostatic pressing (HIP) , applying a pressure of 100MPa at 1073ºK for two hours.

Results and Discussion

Microstructure of the consolidated material consisted mainly of a mixture of copper and B_4C, also included some very fine particles rich on Cr and Fe, which arise from the milling balls, as shown in figure1. Some amount of residual particle copper free was observed heterogeneously distributed on the microstructure.
The precipitation of phases rich in Fe-Cr were confirmed in the pressed composites by TEM analysis as shown in figure 2. TEM examination revealed that there were precipitated free particles. The size of most precipitates is small for EDS analysis, so it is not clear whether the precipitates are Fe carbides or Fe-Cr Compounds (probably sigma phase).
The discontinuous SAD ring pattern shown in figure 2, indicated a non uniform microstructure. White grains on the right in SAD figure, shows a region of relatively little deformation and indicated a non uniform cold working by mechanical alloying.
The EDS analysis of the bigger precipitates with size around 100 nm showed mainly Cr and Fe peaks. (Figure 3) This suggests that the mechanism of nucleation of Cr-Fe rich precipitates is similar to the nucleation mechanism of the precipitates in many precipitation hardening alloys.
Figure 4 is TEM observation, showing grains of different sizes and particles of second phase. Coarser particles around the copper grain boundaries suggest a particle-grain boundary reaction during HIP. Particles according to EDS spectrum correspond to a copper oxide(white) and a Fe-Cr Sigma phase (Black)

Acknowledgment
This study was supported by the D.I. the University of Concepción, Project 99.095.063-1.0; FONDECYT Project Nº 1000476 and CENIM Laboratories.

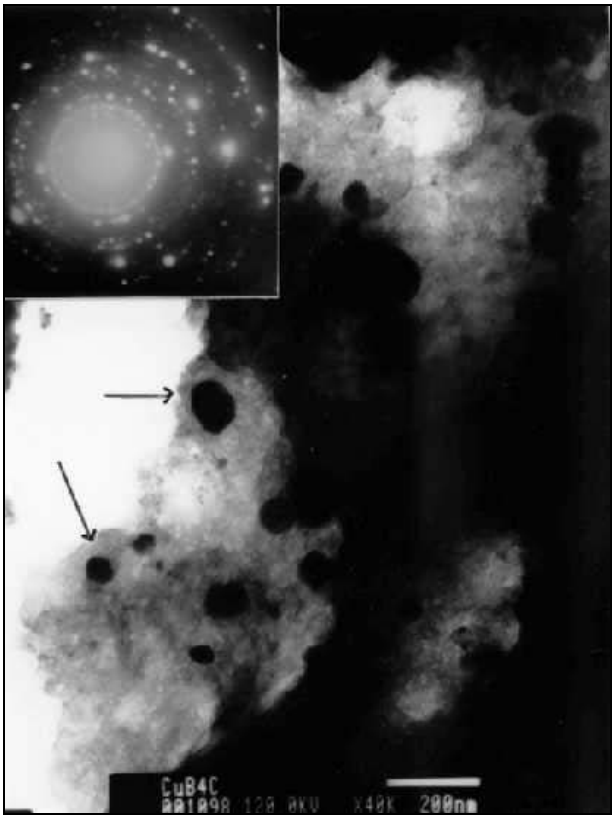

Figure 2. TEM micrograph, shows bright field image
Black particles are precipitates of phase rich in Fe-Cr
On the left side, SAD ring pattern DIF 120kv/60cm

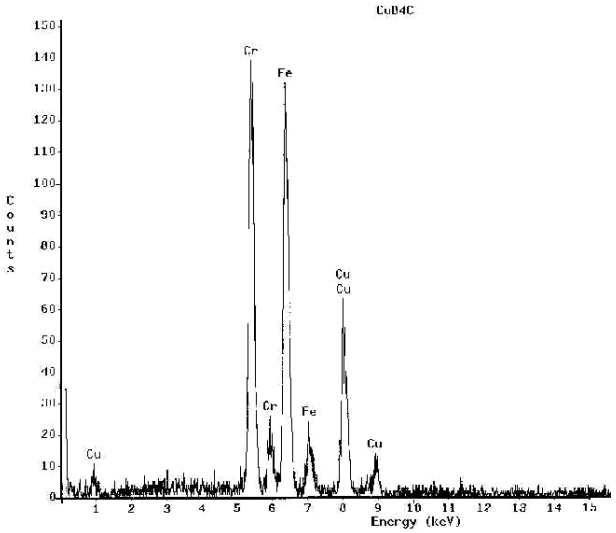

Figure 3. EDS Spectra of precipitates particle on hot pressed Cu-B_4C alloy

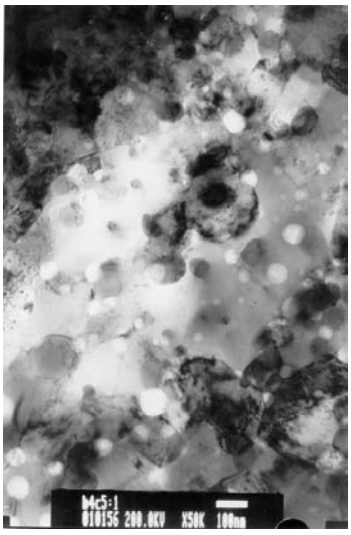

Figure 4 TEM micrograph
Showing particles of second phase.

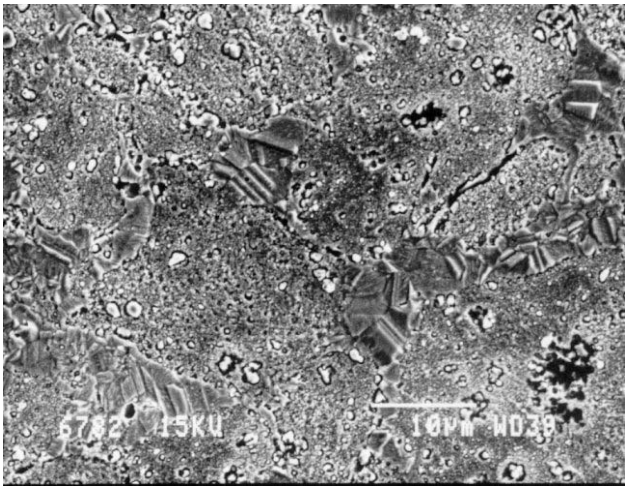

Figure 1 EPMA SEI image of pressed Cu-B_4C alloy, showing a heterogeneous structure.

https://doi.org/10.1017/S1431927603443158 Published online by Cambridge University Press