

STUDY ABOUT THE PROCESSING OF THE PSEUDOALLOYS BASED ON TUNGSTEN POWDER

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ABSTRACT: *This paper presents a study about the processing of the electric contacts, based on tungsten powder, performed through die compaction and cold isostatic pressing.*

KEYWORD: Sintered materials, pseudoalloys, density, pressing isostatic.

INTRODUCTION

Tungsten-based composites are sometimes termed heavy alloys because of the high density, [1]. These pseudoalloys are liquid-phase sintered from a mixture of elemental powders, [2]. Typical compositions are based on W-Ni-Cu or W-Ni-Fe mixtures, with 15 to 98% tungsten, [3]. These are systems where the solid has a high solubility in the liquid. Consequently, sintering densification is by sequence of solid-state activated sintering (during heating), rearrangement (on liquid formation), solution-precipitation with densification concomitant with grain shape accommodation and possibly final-stage solid skeleton densification, [1].

Usually, the uniaxial die compaction is the dominant mode of powder compaction, but isn't the only approach. But the powder does not respond uniformly to the applied pressure, consequently obtaining the target density and the strength levels are the primary concerns.

Isostatic pressing is a P/M forming process that applies equal pressure in all directions on a metal powder compacts thus achieving maximum uniformity of gran structure and density, [4]. Thus, simple or complex shapes requiring uniform strength and fracture resistance are the primary applications for this process.

Compared with cold pressing, isostatic compaction applies pressure uniformly over the entire surface of the mold. Consequently, isostatic compaction provides increased and more uniform density at a given compaction pressure, and relative freedom from compacts defects when applied to brittle or to fine powders, [4].

EXPERIMENTAL RESEARCH

It has been used a W-powder with a big grain-size distribution of 50 μm , type A, a semi fine W-powder with a grain-size distribution of 8-14 μm , type B and a fine W-powder with a grain-size distribution of 6-10 μm . For experimental study it has been used Cu-powder with high purity (99,9%). The grain-size distribution of copper-powder was less than 0.060 mm.

Before utilization, Cu-powder was deoxygenated through reduction into hydrogen. Ni-powder has been obtained from the reducing of the Nickel azotate into hydrogen.

After the obtaining the Nickel, the mixtures with 98%W-2%Ni were compacted old isostatic pressing by the hydrostatic pressures of 150 MPa, 200 MPa and 250 MPa.

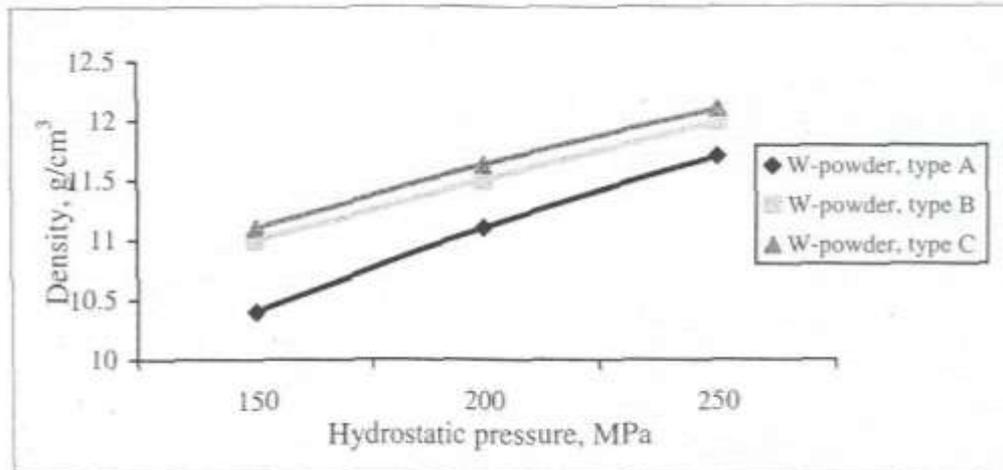


Fig.1. The variation of the green density with the value of the hydrostatic pressure.

It is observed that the maximum values of the green density after cold isostatic pressing were obtained for the fine W- powder. At the same time, it can be noticed the increasing of the density with the value of the cold isostatic pressure. At the same time, it has produced pieces with the classical technology, which requires the uniaxial die compaction. The final chemical contents were obtained then by the copper infiltration in hydrogen at the 1250oC. The formula of the pseudoalloys is the following: tungsten 78%, nickel 2%, copper 20%. Further on, there will be presented the effects of the cold isostatic compaction pressure on the final value of the density and the hardness, after the copper infiltration were the objects of this particular study.

Thus, in the diagram 2 it is shown the graphical dependency of the density variation upon the values of the hydrostatic pressure. In figure 2 it can be noticed the increasing of the density with the value of the cold isostatic pressure.

At the same time, the value of the final density increases with decreasing the grain-size distribution of the W-powder.

Thus, for 250 MPa hydrostatic pressure, the final density for the parts released from a semi fine W-powder, with a grain-size distribution of 8-14 μm , was 16.581 g/cm^3 , respectively a relative density of 97.39% of theoretical density. And also, for the same value of the hydrostatic pressure, for the pieces formed with a fine W-powder, with 6 μm grain-size distribution, the relative density was 98.91% of the theoretical density.

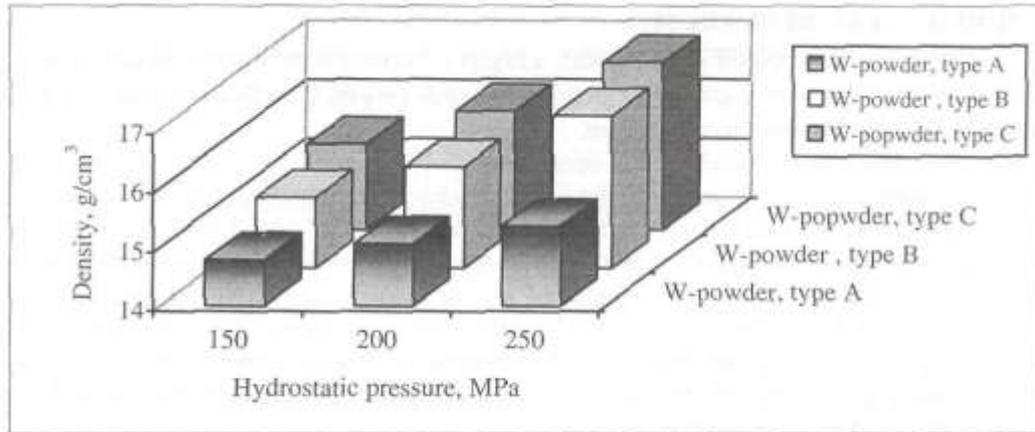


Fig.2. The variation of the density with the hydrostatic pressure.

In the Figure 3 are presented the variation of the hardness with the value of the hydrostatic pressure. In the diagram 3 it can be observed that the values of the final

hardness increases with decreasing the grain-size distribution of the W-powder and the increasing of the hardness with the value of the cold isostatic pressure

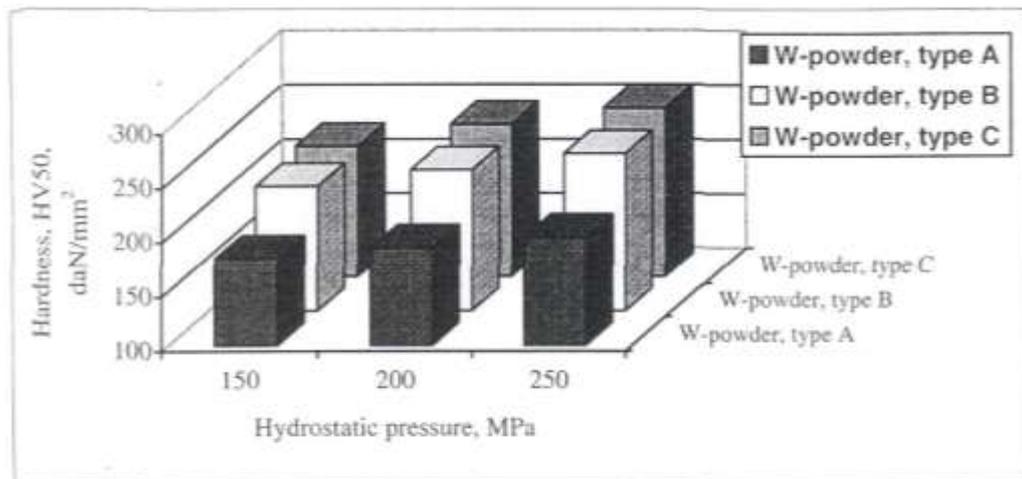


Fig.3. The variation of the hardness with the value of the hydrostatic pressure.

In the Figure 4 is shown a comparison between the values of the final hardness for the parts made with the cold isostating pressing and the pieces manufactured with classic technology, with uniaxial die compaction.

The values of pieces' hardness and density are higher for the parts released with cold isostatic compaction

technologies than for the parts released with the classical PM itinerary. In the next Figures there are presented the electric contacts microstructure achieved by the cold isostatic pressing for each kind of W-powder, at 250 MPa hydrostatic pressures.

In this picture are presented the variation of the hardness with the value of the hydrostatic pressure. In the diagram it

can be observed that the values of the final hardness increases with decreasing the grain-size distribution of the W-powder and the increasing of the hardness with the value of the cold isostatic pressure

CONCLUSIONS

The density and hardness of the pseudoalloys W-Ni-Cu obtained by the cold isostatic pressing are better than the final characteristics of the pieces released by classic technology, where the parts were pressed by uniaxial die compaction. In the same time, the powder with the fine grain-size distribution has the best results.

Usually, the uniaxial die compaction is the dominant mode of powder compaction, but isn't the only approach. But the powder does not respond uniformly to the applied pressure, consequently obtaining the target density and the strength levels are the primary concerns.

The installation for the cold isostatic pressing was released at the Faculty of Mechanics of Craiova, and was attached to a hydraulic press at 300 kN, [4,5]. In the Figure 1 are presented the values of the green density compacts released by cold isostatic pressing.

At the same time, the value of the final density increases with decreasing the grain-size distribution of the W-powder.

Thus, for 250 MPa hydrostatic pressure, the final density for the parts released from a semi fine W-powder, with a grain-size distribution 14 μm , was 16.581 g/cm^3 , respectively a relative density of 97.39% of theoretical density. And also, for the same value of the hydrostatic pressure, for the pieces formed with a fine W-powder, with 6 μm grain-size distribution, the relative density was 98.91% of the theoretical density.

It has been used a W-powder with a big grain-size distribution of 50 μm , type A, a semi fine W-powder with a grain-size distribution of 8-14 μm , type B and a fine W-powder with a grain-size distribution of 6-10 μm . For experimental study it has been used Cu-powder with high purity (99,9%).

It is observed that the maximum values of the green density after cold isostatic pressing were obtained for the fine W-powder. At the same time, it can be noticed the increasing of the density with the value of the cold isostatic pressure. At the same time, it has produced pieces with the classical technology, which requires the uniaxial die compaction

Microscopically, the copper diffusion is made intercrystalline or in lagoon, depending on the intergrain distances.

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