Universidad Carlos III de Madrid

OO/UC3M/51- DEVELOPMENT OF NEW MATERIALS BY HIGH ENERGY MILLING

The Group of Powder Technology (GTP) of the University Carlos III has a wide experience in the development and processing of new materials by Powder Metallurgy (PM).
The mechanical alloying (MA) process, or high energy milling, allows the attainment of powders with compositions impossible to produce by other techniques, with improved properties for structural applications, where mechanical properties are the main requirement, and for applications where other specific properties are needed.
The identification of the specific needs of interested industrial sectors is a critical point in this development.

Description and special features

The Group of Powder Technology (GTP) of the University Carlos III has a wide experience in the development of conventional materials as well as new materials or compositions obtained by high energy milling techniques.
The Mechanical alloying is the latest mechanical process for obtaining powder, broadening its application field from iron based alloys to aluminium alloys and ceramic systems, commercialising numerous materials.

Defined as a solid state milling process, its main advantage is, basically, the possibility to obtain compositions impossible to obtain by other techniques as atomization, raising the solute content far from the equilibrium.
Moreover, the high level of deformation imposed to the powder during milling reduces markedly the grain size, improving their properties far above the obtained by other processes.

The GTP posses a long experience in the processing of Al and Fe by MA, obtaining materials with homogeneous microstructures, and metal Matrix Composites (MMC´s). The advantage derived from this process is related to the high milling energy that reduces or eliminates the problems derived from the introduction of a ceramic reinforcement in the ductile matrix. On one hand it allows the obtaining of a powder with improved properties since, as a solid state process, eliminates the non desirable possible reactions between matrix and reinforcement. On the other hand it also makes possible the addition of a high quantity of reinforcement, giving to a fine and homogeneous distribution of reinforcement through every powder particle, without segregations and agglomerates associated to MMC´s processing.

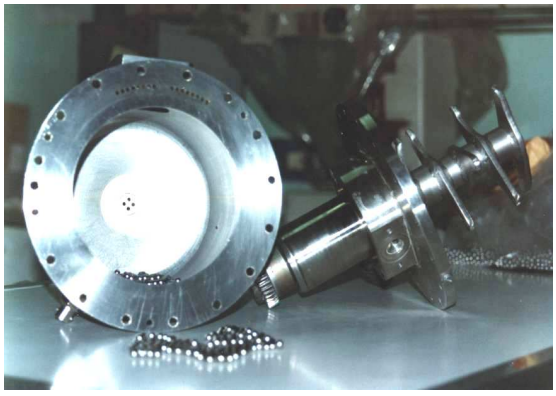

Fig. 1. Attritor high energy mill.

Fig. 2. Advantages of the mechanical alloying process.

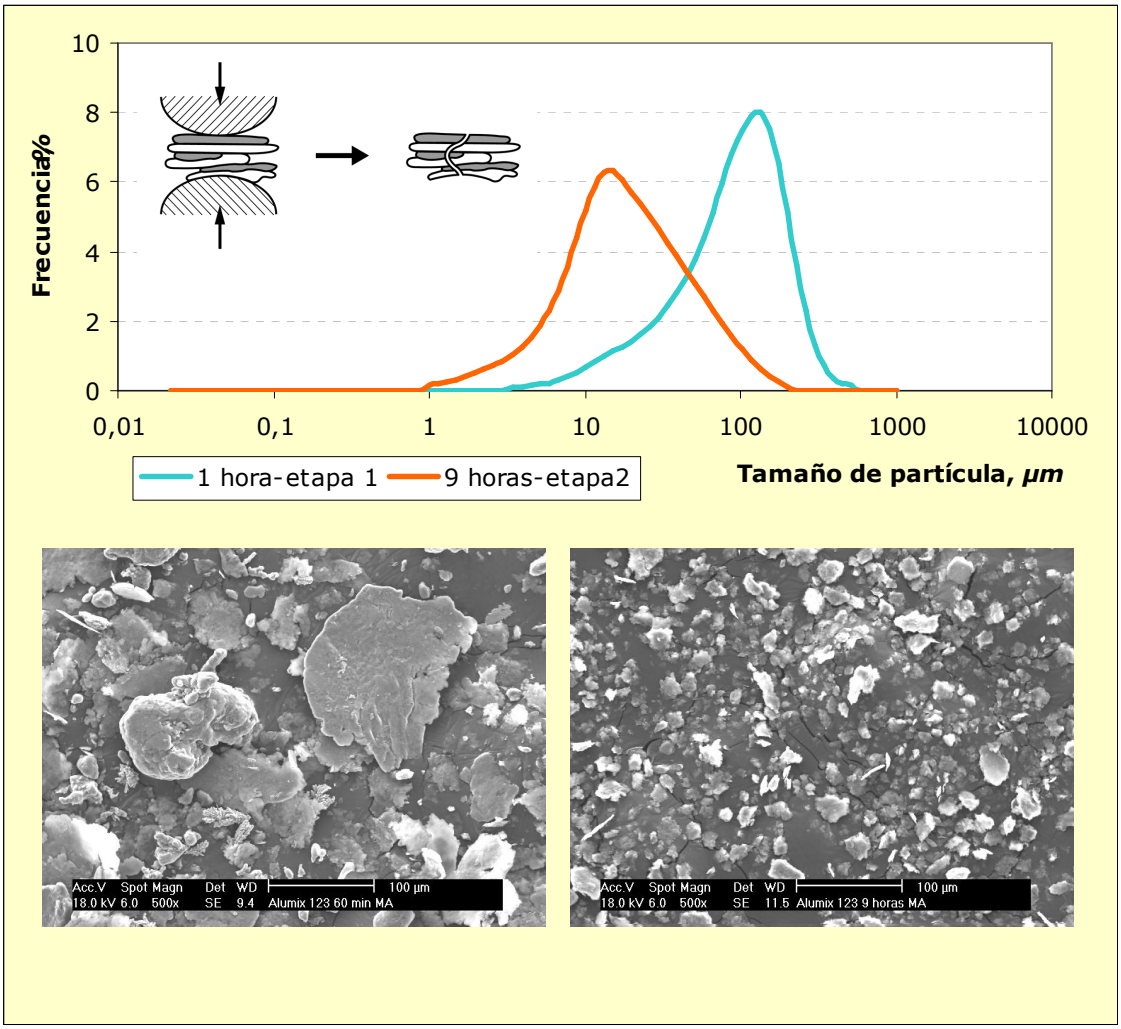

Fig. 3 Evolution of the powder size distribution and morphology with the milling time.

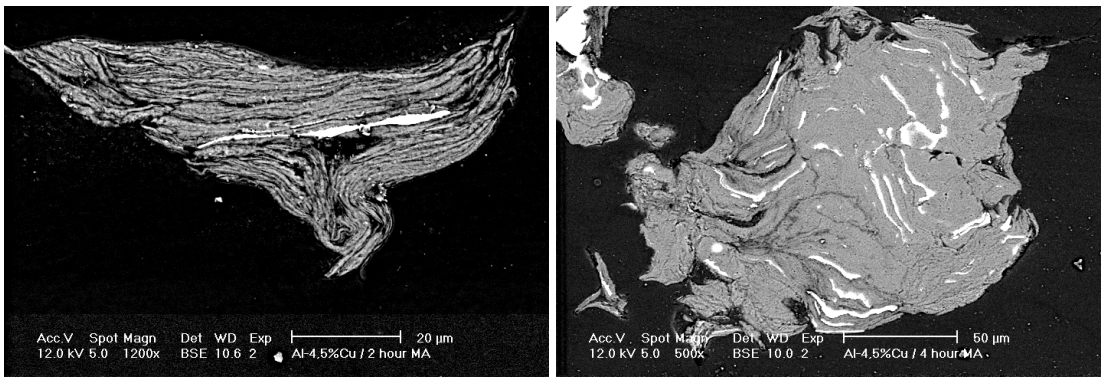

Fig. 4. Microestructure of the Al-Cu powder alter 2 and 4 hours of milling.

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Innovative aspects
Compared to other blending and milling techniques MA provides a finer and more homogeneus microestructure and, consequently, improved properties

Competitive advantages
Development of new materials or conventional materials with improved properties.

Technology Keywords
Metals and alloys; Materials properties, corrosion / degradation; Composite Materials

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