Advanced ceramics with high thermomechanical performance

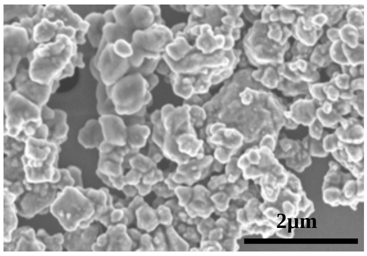
CSIC organization has developed a process for obtaining composite ceramic materials of TiB_2/TiC, TiB_2/TiN y TiB_2 /TiC_x N_{1-x} in a wide range of compositions. It subjects a mixture of the elements in a stoichiometric proportion to a process of high energy milling. The process leads to a highly exothermic reaction that instantaneously spreads. The material obtained can be used in the fabrication of devices which are subjected to high temperatures and corrosive environments.

An offer for Patent Licensing

Resistant to high temperatures and corrosive environments

The method developed starts with a treatment of the elements titanium, boron, and, if applicable, carbon, by a high energy milling. The elements, all of them in powder form, are in a stoichiometric proportion according to the desired composition and in an atmosphere of helium, argon or nitrogen, depending on the composite material sought. When nitrogen is used, nitride or carbonitride of titanium is achieved, by its incorporation in the composite.

The high energy milling treatment first leads to the mixing of the raw materials by means of a reduction of particle size and the mechanical activation achieved. After that, an exothermic reaction occurs which instantaneously spreads to the entire mass, resulting in the final composite material. This exothermic reaction is self-sustaining, so, unlike other state of the art processes, it requires neither any type of heat treatment to induce the reaction, nor any prior or subsequent heat treatment to obtain a crystallisation of the phases.



"Material for the preparation of advanced ceramic materials with high thermomechanical performance, particularly for the fabrication of devices subjected to high temperatures and corrosive environments"

Main innovations and advantages

- Simple procedure that requires simple equipment: it can be performed on an industrial scale without added problems.
- The method allows to obtain very small particle size (submicron and/or nanometric scale) with a narrow size distribution and a greater homogeneity.
- Alternative to other methods that use carbothermal and/or borothermal reductions requiring high temperatures (>1500 °C). The patented process requires no heat input and prevents against the formation of undesirable secondary phases, such as titanium dioxide, titanium oxy-carbonitride and titanium borate, providing a purer composite material.
- The procedure uses the solid form of the elements Ti-B-C so allows it to achieve a high accuracy in the final composition of the composite.
- The method is performed at room temperature, no waste is produced and is easily reproducible.
- The process saves time and energy compared to conventional procedures.
- The procedure does not use liquid precursors, which are usually flammable, require a high purity, have a high cost, and cause waste and environmental problems because of their toxicity.

Patent Status

Spanish patent application filed.

For further information please contact

Ana García Navarro, Ph.D.

Material Sciences Area
Deputy Vice-Presidency for Knowledge Transfer
Spanish National Research Council (CSIC)

Tel.: + 34 – 95 448 95 27
Fax: + 34 – 95 446 06 65
E-mail: ana.garcia@icmse.csic.es

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