ABSTRACT

Due to the rapid technological advances of recent decades, new needs have arisen that require the generation of new on demand materials that meet certain functionalities or acquire specific characteristics. In addition to the design of tailor-made materials, there is the problem of forming processes, which in the case of ceramic materials are long processes that require high temperatures and entail high energy consumption.

Ceramic materials such as zirconia (ZrO_2) have attracted the attention of researchers due to their excellent mechanical, thermal and high chemical resistance properties. In addition, it should be mentioned that it is a highly biocompatible material that does not react in humid environments, which makes it suitable for use in a wide range of cross-cutting sectors, ranging from aerospace to prosthetic medicine. One of the important characteristics of zirconia, given its nature as a white crystalline solid, is that it is easy to color, being able to obtain shades very similar to those of human dentin with small doping of metal oxides, which is why its use has been widely extended in dentistry. Another significant property that makes this ceramic an exceptional material is its high ionic conductivity, which allows it to be used as an electrolyte in solid oxide fuel cells (SOFC).

All these properties together make zirconia a very versatile material with a wide range of possible applications, ranging from solid fuel cells, coatings for turbine propellers, heat exchangers, as well as for prosthetic medicine, dentistry and other applications.

The purpose of this doctoral thesis is to obtain zirconia-based nanostructured ceramic materials that can be used in the fabrication of new composites with tailored properties for the various sectors mentioned above. For this purpose, the non-conventional microwave-based sintering technology will be used, which allows us to consolidate highly densified materials at relatively low temperatures and very short cycle times, as well as being a clean, ecological and environmentally sustainable process.

In this research, the study of different zirconia-based composites stabilized with yttria has been proposed: zirconia doped with iron oxide (Fe_2O_3), zirconia composites with lanthanum manganite doped with strontium (LSM) and zirconia-zirconia composites ($ZrSiO_4$).

The results obtained from this research will allow, on the one hand, to determine if the non-conventional fast sintering technique used improves the mechanical, electrical, magnetic and chemical properties of the materials in comparison with conventional sintering, and on the other hand, to advance in the design and fabrication of advanced ceramic materials.