New considerations about the fracture mode of PZT ceramics

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Abstract

Sintered bulk ceramics such as PZT are brittle materials. This implies macroscopically a statistical distribution of the ultimate strengths, because defects such as pores or cracks are responsible for the initiation of the specimen failure. Another aspect of this fracture phenomenon is the path the cracks propagate inside the material, along grain boundaries or through the grains themselves. An experimental study is carried out on hard and soft PZT by means of a SEM quantitative analysis of tensile fractured areas. This reveals that the fracture mode is mixed, although it seems to be rather intragranular for hard ceramics and more intergranular for soft ones. Further investigations deal with the characterization of the residual porosity, which has to be distinguished from the population of critical defects. This porosity is located at grain boundaries and likely acts too as a stress concentrator. Its influence on the fracture mode and mechanical properties has been highlighted. For doped hard and soft PZT, a careful analysis of the microstructure is thus achieved through TEM micrographs. It reveals no second phase such as ZrO_2, which may enhance the fracture toughness, but different grain boundaries configurations according to the type of ceramic. Furthermore, domain structure is analysed for hard and soft PZT.