Electro-thermo-mechanical finite element analysis on DC pulse resistance pressure sintering process of zirconia part

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Abstract

Some difficulties have arisen on appropriate design of the graphite dies, on applying the DC pulse resistance pressure sintering process, which is more efficient process than other conventional sintering processes such as hot pressing process, to a complex shaped part of non-conductive ceramics powder such as zirconia powder. In the present paper, the non-steady electro-thermo-mechanical finite element analysis of the sintering process of the zirconia cylindrical can was performed. As a result, it was found that the enough heating of the graphite dies that contacts with zirconia powder, and heat transmission from the die to zirconia powder was essential for the success of the sintering with adequate density. Moreover, the lower density region was found at the inside of the can during the process, which corresponded to the region where the convex shape formed in experiments. Furthermore, the high tensile residual circumferential stress was observed at the sidewall from the simulation of the cooling process, which is caused by the different thermal expansion ratio of the graphite and zirconia materials. This stress was considered to be related with the fracture of the can longitudinally during cooling process in experiments.