World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:13, No:08, 2019

A Study of Electric Generation Characteristics for Thin-Film Piezoelectric $PbZrTiO_3$ Ceramic Plate during the Static and Cyclic Loading Conditions

Authors : Tsukasa Ogawa, Mitsuhiro Okayasu

Abstract : To examine the generation properties of electric power for piezoelectric (PbZrTiO3) ceramic plates, the electric-power generation characteristics were examined experimentally and numerically during cyclic bending under various loading fixtures with different contact condition, i.e., point and area contact. In the low applied loading condition between 10 and 50 N, increasing the load-contact area on the piezoelectric ceramic led to a nonlinear decrease in the generated voltage. Decreasing contact area, including the point contact, basically enhanced the generated voltage, although the voltage saturated during loading when the contact area is less than ϕ5 mm, which was attributed to the high strain status, resulting in the material failure, i.e., high stress concentration. In this case, severe plastic deformation and the domain switching were dominated failure modes in the ceramic. From this approach, it is clear that the applied load became more larger (50 ~100 N), larger contact area (ϕ10 ~ ϕ20 mm) became advantageous for power generation. Based upon this cyclic loading was carried out to investigate the fatigue characteristics of the piezoelectric ceramic late. For all contact conditions, electric voltage dropped in the beginning of the cyclic loading, although the higher electric generation was stable in the further cyclic loading for the contact area of ϕ10 ~ ϕ20 mm. In constant, further decrement of electric generation occurred for the point contact condition, and the low electric voltage was generated for the larger contact condition.

Keywords : electric power generation, piezoelectric ceramic, lead zirconate titanate ceramic, loading conditions
Conference Title : ICCMAME 2019 : International Conference on Complex Metallic Alloys and Metallurgical Engineering
Conference Location : Venice, Italy
Conference Dates : August 13-14, 2019