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# Finite Element Analysis of Fracture and Polarization Switching Behavior in Modified Small Punch Testing of Piezoelectric Ceramics

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FINITE ELEMENT ANALYSIS AND MODIFIED SMALL PUNCH TESTING FOR DETERMINING THE ELECTRIC FRACTURE AND POLARIZATION SWITCHING BEHAVIOR OF PIEZOELECTRIC CERAMICS Yasuhide Shindo*, Fumio Narita, Yasuyo Magara and Masaru Karaiwa *Department of Materials Processing, Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan This paper discusses the fracture behavior of a piezoelectric ceramic under applied electric fields. The modified small punch (MSP) tests were made on a commercial piezoelectric ceramic plate. The fracture initiation loads under different electric fields were obtained from the experiment. Nonlinear three-dimensional finite element analysis was also used to study experiments with the MSP technique and to calculate the MSP energy and maximum strain energy density. The effects of applied electric field and 180, 90 degree polarization switching on the MSP energy and maximum strain energy density are discussed, and the model predictions are compared with the results of the experiments. The results show that measured fracture initiation load, calculated MSP energy and maximum strain energy density are sensitive to the change in the applied electric field and polarization switching. The polarization switching zones corresponding to combined mechanical and electrical loads are obtained and discussed in detail.

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