Pergamon

Mechanics Research Communications, Vol. 28, No. 3, pp. 289–295, 2001

0093-6413/01/$–see front matter

PII: S0093-6413(01)00176-8

Investigation of anti-plane shear behavior of two collinear cracks in a piezoelectric materials strip by a new method

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(Received 29 November 2000; accepted for print 16 May 2001)

1. Introduction

Piezoelectric materials produce an electric field when deformed, and undergo deformation when subjected to an electric field. The coupling nature of piezoelectric materials has attracted wide applications in electric-mechanical and electric devices, such as electric-mechanical actuators, sensors and structures. When subjected to mechanical and electrical loads in service, these piezoelectric materials can fail prematurely due to their brittleness and presence of defects or flaws produced during their manufacturing process. Therefore, it is important to study the electro-elastic interaction and fracture behaviors of piezoelectric materials. In the past several years, theoretical studies of fracture in piezoelectric materials were carried out by many researchers, such as in [1~5]. Recently, Chen and Karihaloo[6] considered an infinite piezoelectric ceramic with impermeable crack-face boundary condition under arbitrary electro-mechanical impact loading. The impermeable boundary condition on the crack surface was widely used in the works, such as in [1,6]. To our knowledge, the problem of two collinear impermeable cracks in piezoelectric materials strip has not been studied. The problem in the elastic strip had been investigated in Lowengrub's and Zhou's papers[7~10]. However, Lowengrub[7] presented solution which was only suitable for $\delta>>1$ ($\delta=h/l$. h is the half width of the strip, l is the half length of the crack).