ՀԱՅԱՍՏԱՆԻ ԳԻՏՈՒԹՅՈՒՆՆԵՐԻ ԱԶԳԱՅԻՆ ԱԿԱԴԵՄԻԱՅԻ ՏԵՂԵԿԱԳԻՐ
ИЗВЕСТИЯ НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК АРМЕНИИ

Մեխանիկա 54, №1, 2001 Механика
УДК 539.3

Magnetic Field Effects on Fracture and Deformation of Electromagnetic Elastic Plates

Yasuhide Shindo
Department of materials Processing, Graduate School of Engineering, Tohoku University
Aoba-yama 02, Sendai 980-8579, Japan
e-mail: shindo@material.tohoku.ac.jp

Ց. Շինդո
Մագնիսական դաշտի ազդեցությունը առաձգական սալերի ամրության և դեֆորմացիայի վրա

Abstract

Design and development of superconducting structures requires basic research on magnetic fracture mechanics. In the theory of brittle fracture in a strong magnetic field, usually we consider linear magneto-elastic solutions of crack problems. Examples including analysis of magneto-elastic crack problems are received to show the effect of magnetic field on the mechanical behavior of cracked materials.

1) Scattering of Flexural Waves by a Crack in an Electrically Conducting Plate

If electrically conducting materials are used in a strong magnetic field, we must consider the effect of induced currents. The scattering of time harmonic flexural waves by a through crack in an electrically conducting plate under a uniform magnetic field is analyzed to show this effect. We discuss two special cases of quasistatic electromagnetic field and perfect conductivity.

2) Fracture and Deformation Ferromagnetic of a Plate

Ferromagnetic ferritic/martensitic steels are currently under study as candidate materials for first wall and structural materials applications for commercial fusion reactors. If ferromagnetic materials are used in the strong magnetic field, we must consider the effect of induced magnetization. Fracture and deformation of a ferromagnetic plate in a magnetic field is investigated to show this effect.

(a) Bending of a ferromagnetic plate

Theoretical analysis and experimental evidence are presented for the bending of a soft ferromagnetic plate in a magnetic field. The cantilevered plate is bent by a normal point force at the end and is permeated by a static uniform magnetic field normal to the plate surface. The theoretical predicted results are confirmed experimentally.

(b) Bending of a through-cracked ferromagnetic plate

The linear magneto-elastic problem for a soft ferromagnetic plate of finite length with a through crack under bending is analyzed. A simple experimental procedure involving measurement of strain through strip gages with five strain sensors per strip gage, has been also developed to determine the magnetic moment intensity factor. Theoretical predictions are compared with experimental data and good agreement is observed.

(c) Scattering of flexural waves by a through crack in a ferromagnetic plate

The scattering of time harmonic flexural waves by a through crack in a ferromagnetic plate under a uniform magnetic field is analyzed. Two cases are considered: the soft ferromagnetic plate and the magnetically saturated plate.