Numerical Approach to Thermoelectroelastic Analysis of a Piezoelectric Semi-infinite Body with D_∞ Symmetry Subjected to Heat Convection

Masayuki Ishihara[†1, *], Yoshihiro Ootao[†2], and Yoshitaka Kameo[†3]

[†1, †2] Graduate School of Engineering, Osaka Prefecture University
1-1 Gakuen-cho, Naka-ku, Sakai-shi, Osaka 599-8531, JAPAN
[†1]e-mail: ishihara@me.osakafu-u.ac.jp
[†2]e-mail: ootao@me.osakafu-u.ac.jp

[†3] Institute for Frontier Life and Medical Sciences
Kyoto University
53 Kawahara-cho, Shogoin, Sakyo-ku, Kyoto 606-8507, Japan
Email: kameo@frontier.kyoto-u.ac.jp

ABSTRACT

With the aim of understanding the responses to the thermal disturbances that the green materials such as wood and poly-L-lactic acid undergo, we approach the subject in a mesoscopic viewpoint in which wood and poly-L-lactic acid are regarded as bodied with D_∞ symmetry, and numerically study the thermoelectroelastic field in such a body subjected to heat convection. The analytical procedures for the isothermal problems [1, 2] are extended to include thermal effects. First, the constitutive equations are derived considering the microstructures and their combined behaviors. Then, the displacement and electric field are expressed in terms of two types of displacement potential functions, the electric potential function, and the two types of thermoelastic displacement potential functions. Their governing equations are obtained using the fundamental equations for the thermoelectroelastic field. As a result, the field quantities are found to be expressed in terms of the general solutions of two elastic displacement potential functions and two piezoelastic displacement potential functions, each of which satisfies a Laplace equation with respect to the appropriately transformed spatial coordinates, combined with the particular solutions of two thermoelastic displacement potential functions. By use of thus-constructed analytical technique, the thermoelectroelastic field in a semi-infinite body subjected to heat convection is analyzed, and the solutions of the field quantities are obtained in the Fourier integral forms. Then, the solutions are evaluated numerically by performing the integrations, and the necessities to include the thermal effect into the electroelastic analysis are clearly illustrated.

REFERENCES

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