On static hierarchical models of thermoelastic piezoelectric shells

Gia Avalishvili [a], *Mariam Avalishvili* [b]
E-mail: gia.avalishvili@tsu.ge
[a] Chair of Numerical Analysis and Computational Technologies, I. Javakhishvili Tbilisi State University,
3, I. Tchavtchavadze Ave., 0179 Tbilisi
[b] School of Science and Technology, University of Georgia,
77a, M. Kostava Str., 0175 Tbilisi

In this paper thermoelastic piezoelectric shell with thickness, which may vanish on a part of the lateral boundary, consisting of several inhomogeneous anisotropic layers is considered. Applying variational approach boundary value problem corresponding to static three-dimensional model [1, 2] of thermoelastic piezoelectric body with regard to magnetic field is studied, when along certain parts of the boundary mechanical displacement, temperature, electric and magnetic potentials vanish, while on the remaining parts of the boundary components of electric displacement, magnetic induction and heat flux along the outward normal vector of the boundary are given, and on the interface surfaces between layers the rigid contact conditions are fulfilled. In order to construct two-dimensional models of thermoelastic piezoelectric shell spectral approximation method is used, which is a generalization of dimensional reduction method suggested by I. Vekua [3] in the classical theory of elasticity for prismatic shells. Applying variational approach a hierarchy of static two-dimensional models is constructed and the existence and uniqueness of solutions of the corresponding boundary value problems in suitable weighted Sobolev spaces is investigated. Moreover, it is proved that the sequence of vector-functions of three variables restored from the solutions of the two-dimensional problems converges to the solution of the original three-dimensional problem in the corresponding spaces and under additional conditions estimate of the rate of convergence is obtained.

Acknowlegment. This work was supported by Shota Rustaveli National Science Foundation (SRNSF) [Grant number 217596, Construction and investigation of hierarchical models for thermoelastic piezoelectric structures].

References

[1] J.Y. Li, Magnetoelectroelastic multi-inclusion and inhomogeneity problems and their applications in composite materials, Int. J. Eng. Sci., 38 (2000), 1993-2011.
[2] D. Natroshvili, Mathematical problems of thermo-electro-magneto-elasticity, Lecture Notes of TICMI, 12 (2011).
[3] I.N. Vekua, On a way of calculating of prismatic shells, Proceedings of A. Razmadze Institute of Mathematics of the Georgian Academy of Sciences, 21 (1955), 191-259 (Russian).