EVOLUTION OF VISCOELASTIC CONTACT PROBLEMS FOR PIEZOELECTRIC MATERIALS WITH ADHESION

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In this paper we consider a second order evolution inclusion with a coercive viscosity operator and a multivalued term of subdifferential form. The study is motivated by the dynamic problem of frictional contact between a viscoelastic piezoelectric deformable body and a foundation. The interaction between the body and the foundation is described, due to the skin effects, by a nonmonotone possibly multivalued law between the bonding forces and the corresponding displacements. This law is expressed by the Clarke subdifferential of a locally Lipschitz nonconvex nonsmooth superpotential and leads to a hemivariational inequality of hyperbolic type. Such inequality results from the d’Alembert principle for a dynamic mechanical system (1; 6).

On the other hand our model concerns piezoelectric materials. Such materials are dielectrics which exhibit significant deformations in response to an applied electric field (direct effect) as well as dielectric polarization in response to mechanical strains (converse effect). Both effects were discovered by Jacques and Pierre Curie in 1880-1881 but only recently such bodies have been used in smart material technology. The linear constitutive equations coupling the mechanical and electrical quantities in the piezoelectric materials were formulated by Voigt in 1910.

Some materials are naturally piezoelectric, e.g. crystals, living bones, human skin, etc., other that are manufactured with piezoelectric characteristics are very important in many applications, e.g. in biomechanics, biomedicine, structural mechanics and in particular as sensors, actuators, transducers, speakers and electronic clocks.

The present paper is a continuation of (2; 3; 4; 5), where the existence and uniqueness results for the hemivariational inequalities modeling the frictional contact for the piezoviscoelastic materials were delivered. Our model problem consists of a system coupled with the evolution hemivariational inequality for the displacement, a time dependent stationary equation for the electric potential and an ordinary differential equation for the bonding field. We prove the existence of a weak solution to an abstract formulation of the mechanical problem. Applications to contact problems of electro-viscoelasticity are discussed.

REFERENCES