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AN ELECTRO-VISCOELASTIC CONTACT PROBLEM WITH ADESION

Mircea Sofonea and Rachid Arhab

Laboratoire de Mathématiques et Physique pour les Systèmes
Université de Perpignan, 52 Avenue Paul Alduy, 66 860 Perpignan, France

Abstract. We consider a quasistatic contact problem between a piezoelectric body and an obstacle, the so-called foundation. The contact is frictionless and it is modelled with a modified normal compliance condition in which adhesion of contact surfaces is taken into account. The evolution of the bonding field is described by a first order differential equation and the material's behavior is modelled with an electro-viscoelastic constitutive law. We derive a variational formulation of the problem and prove an existence and uniqueness result for the weak solution. The proof is based on the construction of three intermediate problems for the displacement field, the electric potential field and the bonding field, respectively. We prove the unique solvability of the intermediate problems, then we construct a contraction mapping whose unique fixed point is the solution of the original problem.
Keywords. Electro-viscoelastic material, frictionless contact, normal compliance, adhesion, fixed point, weak solution.
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1 Introduction

Considerable progress has been achieved recently in modelling, mathematical analysis and numerical simulations of various contact processes and, as a result, a general Mathematical Theory of Contact Mechanics is currently emerging. It is concerned with the mathematical structures which underlie general contact problems with different constitutive laws, i.e., materials, varied geometries, and different contact conditions, see for instance [8,12] and the references therein. Its aim is to provide a sound, clear and rigorous background to the constructions of models for contact, proving existence, uniqueness and regularity results, assigning precise meaning to solutions, among others.

In this paper we study a quasistatic frictionless contact problem for electro-viscoelastic materials with adhesion, in the framework of the Mathematical Theory of Contact Mechanics; our interest is to describe a physical process in which both contact, adhesion and piezoelectic effect are involved, and to show that the resulting model leads to a well-posedness mathematical problem. Taking into account the piezoelectric effect in the study of a