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A Dynamic Contact Problem for Elasto-Viscoplastic Piezoelectric Materials with Normal Compliance, Normal Damped Response and Damage

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Abstract: This work studies a mathematical model involving a dynamic contact between two elasto-viscoplastic piezoelectric bodies with damage. The contact is modelled with a combination of a normal compliance and a normal damped response law associated with friction. We derive a variational formulation of the problem and we prove an existence and uniqueness result for the weak solution. The proof is based on the classical existence and uniqueness result for parabolic inequalities, differential equations and fixed-point arguments.

Keywords: *dynamic process; elastic-viscoplastic piezoelectric materials; damage; normal compliance; normal damped; fixed point.*

Mathematics Subject Classification (2010): 35Q74, 47H10, 49J40, 74D10.

1 Introduction

In this paper we study a contact problem which involves viscous friction of Tresca type described in [1]. A nonlinear elasto-viscoplastic constitutive law is used to model the piezoelectric material. The piezoelectricity can be described as follows: when mechanical pressure is applied to a certain class of crystalline materials (e.g., ceramics $BaTiO_3$, $BiFeO_3$), the crystalline structure produces a voltage proportional to the pressure. Conversely, when an electric field is applied, the structure changes its shape producing dimensional modifications in the material. Different models have been developed to describe the interaction between the electrical and mechanical fields, see, for example, [5, 17] and the

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