

A monolithically coupled chemo-mechano-thermodynamical contact formulation

Roger A. Sauer^{1,2,3}

¹*Institute for Structural Mechanics, Ruhr University Bochum, 44801 Bochum, Germany,*

E-mail: roger.sauer@rub.de

²*Dept. of Structural Mechanics, Gdańsk University of Technology, 80-233 Gdańsk, Poland*

³*Dept of Mechanical Engineering, Indian Institute of Technology Guwahati, Assam 781039, India*

This work presents a general contact formulation for coupled chemical, mechanical and thermal contact. It is derived from the balance laws of mass, momentum and energy at the contact interface, thus exposing the general coupling between the different fields [1]. Chemical bonding and debonding is assumed to occur between bonding sites following a kinetic reaction equation. A quadratic contact potential is used to describe the free energy of contact, bonding and debonding. The proposed formulation corresponds to the known thermo-mechanical contact equations [2] extended to chemical contact, see Figure 1. The formulation is discretized and implemented in the 3D nonlinear finite

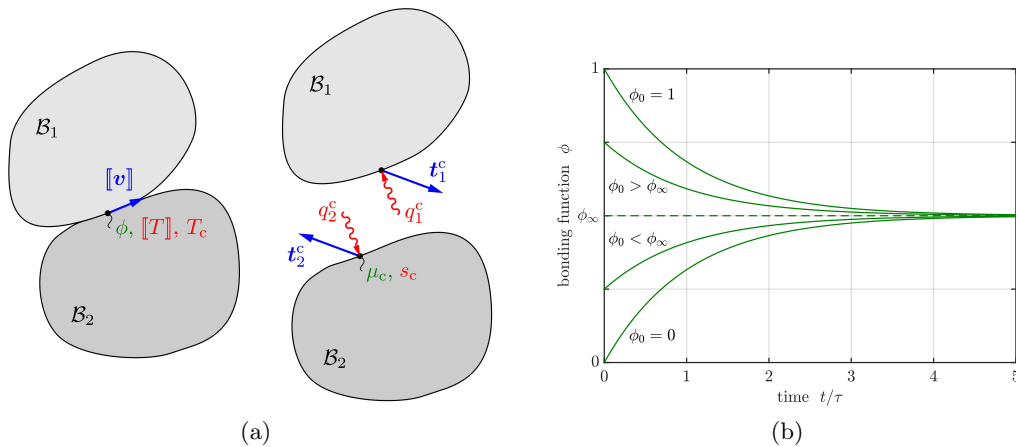


Figure 1: Thermo-chemo-mechanical contact [1]: (a) Bodies in contact with their chemical, mechanical and thermal contact fields. (b) Exemplary evolution of the contact bonding state for various initial conditions.

element framework of [3] using a fully monolithic coupling formulation. Implicit time integration is used of the chemical evolution equations. The formulation is illustrated by several applications. A particular focus is placed on implant osseointegration [4] and thermo-chemo-mechanical bonding.

References

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