11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Investigation of the poling process in multiferroic composites via FEM simulation

***Artjom Avakian[1], Roman Gellmann[2] and Andreas Ricoeur[3]**

[1, 2, 3] Institute of Mechanics, University of Kassel, Moenchenbergstr. 7, Kassel 34125, Germany,
[1] artjom.avakian@uni-kassel.de

Key Words: *Multiferroic, Magnetoelectric, Ferromagnetic, Ferroelectric, Homogenization.*

The coupling of magnetic and electric fields due to the constitutive behavior of a material is commonly denoted as ME-effect. The latter is only observed in a few crystal classes exhibiting a very weak coupling which can hardly be exploited for technical applications. Much larger coupling coefficients are obtained in composite materials, where ferroelectric and ferromagnetic constituents are embedded in a matrix. The ME-effect is then induced by the strain of the matrix converting electrical and magnetic energies based on the ferroelectric and magnetostrictive effects.
In this paper, the theoretical background of linear and nonlinear constitutive multifield behavior as well as the Finite Element implementation are presented. Nonlinear material models describing the magneto-ferroelectric or electro-ferromagnetic behaviors are presented. On this basis the polarization in the ferroelectric and magnetization in the ferromagnetic phases are simulated and the resulting effects analyzed. Numerical simulations focus on the prediction of local orientations and residual stress going along with the poling process, thus supplying information on favorable electric-magnetic loading sequences. Further, the developed tools enable the prediction of the electromagnetomechanical properties of smart multiferroic composites [1] and supply useful means for their optimization. The resulting final state of a poling simulation can be implemented as a starting condition for approximate linear simulations and multifield homogenization procedures.

REFERENCES

[1] A. Avakian and A. Ricoeur, Enhancement of magnetoelectric coupling in multiferroic composites via FEM simulation. ISBN 978-89-89693-37-6-93530, Proceedings of the 2013 World Congress on Advances in Structural Engineering and Mechanics (ASEM13), Korea, p. 3969-3978, 2013.