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A THERMAL MULTISCALE MODEL CONSIDERING MICROSCOPIC HEAT SOURCES

Sebastián Giusti[a], Pablo Sanchez[b] and Sebastian Toro[b]

[a]*Universidad Tecnológica Nacional – Facultad Regional Córdoba. CONICET, Argentina, sgiusti@civil.frc.utn.edu.ar*

[b]*CIMEC, Universidad Nacional del Litoral - CONICET, Argentina, psanchez@intec.unl.edu.ar*

Abstract. Based on the volume averaging of the microscopic temperature and temperature gradient field over a local representative volume element (RVE), in this work we present a variational formulation for multi-scale constitutive models in heat conduction problem considering the microscopic heat sources.

In order to describe the RVE material behavior, we use local continuum constitutive theories. The proposed formulation provides an axiomatic framework within which each class of multiscale model is completely defined by a specific choice of kinematical constraints over the RVE. As consequences of the Hill-Mandel Variational Principle of Macro-Homogeneity, we obtain the equilibrium problem to solve at the RVE level as well as the homogenization expressions for the heat flux and heat source. This approach allows us consider the (possibly non-linear) microscopic heat sources in the microscopic equilibrium problem for microscopic temperature fluctuation field. Then, the homogenized heat flux and heat source depends explicit and implicitly on the macroscopic temperature gradient. Thermodynamic aspects of the formulation and numerical implementation details are also described in this contribution. Finally, we present some numerical examples in the context of the finite element method.