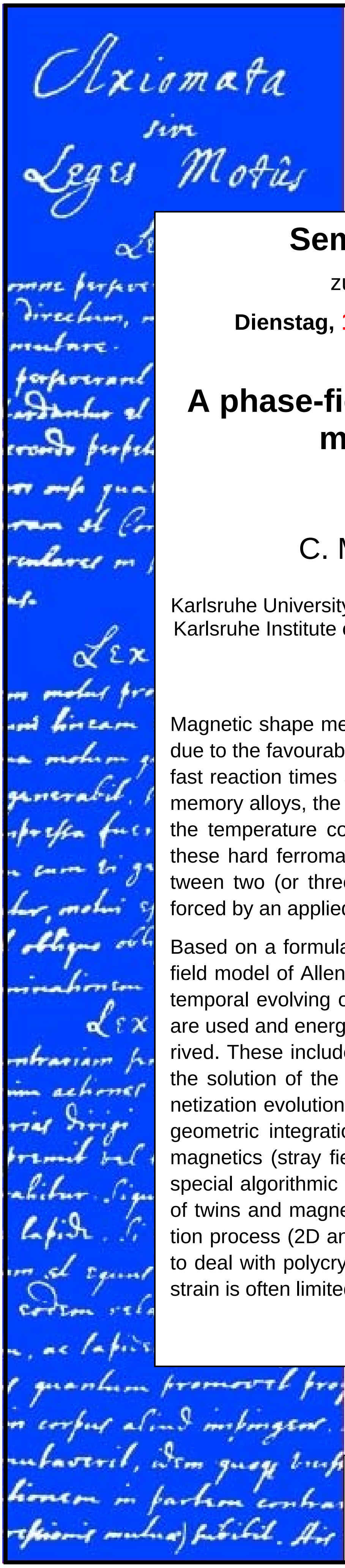

Friedrich-Alexander-Universität Erlangen-Nürnberg

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Dienstag, 16.11.2010, 16:00 Uhr, Egerlandstr. 5, Raum 0.044

A phase-field model for twin boundary motion in magnetic shape memory alloys

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Magnetic shape memory (MSM) alloys have attained major interest in the last decade due to the favourable properties they offer for the application as actuators, as there are fast reaction times and low energy costs in operation. Contrary to conventional shape memory alloys, the large recoverable strain (up to 10 % for Ni2MnGa) does not rely on the temperature controlled reversible transformation from austenite to martensite in these hard ferromagnetic materials. Instead, a reversible rearrangement process between two (or three) martensite variants in the low temperature martensitic state is forced by an applied magnetic field.

Based on a formulation of the Helmholtz free energy density, we apply a multi-phase field model of Allen-Cahn type to describe the twin rearrangement in Ni2MnGa. Here, temporal evolving order parameters related to the different self strains of the variants are used and energy contributions for twin interfaces and the bulk phase states are derived. These include magneto-elastic energies and micromagnetic energies and imply the solution of the elastic (displacement field) and magnetic sub-problem. The magnetization evolution is calculated using the Landau-Lifshitz-Gilbert equation applying a geometric integration scheme. Particularly the long range contributions from micromagnetics (stray field) limit the computationally tractable domain size, hence require special algorithmic treatment. One important question deals with the intricate coupling of twins and magnetic domains. Here, simulation results of the reversible transformation process (2D and 3D) in single crystals are shown. We further give first ideas how to deal with polycrystals as technically important materials, where the large magneto-strain is often limited by grain interfaces.

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