Nanostructured materials | Jožef Stefan Institute Ljubljana, Slovenia

SEMINAR

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From Thermodynamics to Microstructure: A Coupled CALPHAD - Phase Field Modelling Framework for Nd-Fe-B Permanent Magnets

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Understanding and predicting microstructure evolution during thermal processing of Nd-Fe-B permanent magnets remains crucial for controlling coercivity and optimizing magnet performance. Traditionally, such evolution has been inferred through post-mortem characterization, including interrupted sintering experiments, which only offer discrete snapshots of a continuous process.

In this lecture, I present a modelling framework that couples CALPHAD-based thermodynamic databases with advanced multi-phase, multi-component phase-field simulations tailored to Nd-Fe-B alloys. This approach enables time-resolved analysis of grain growth by solution reprecipitation, elemental diffusion, and wetting phenomena during liquid-phase sintering. The model will first be applied to the ternary Nd-Fe-B system and systematically compared to equilibrium calculations, with future extensions planned for systems containing elements such as Cu, Co, Dy, Tb, and Pr.

Ultimately, this framework aims to provide a predictive, thermodynamically consistent tool for exploring processing–microstructure relationships and supporting the design and optimization of high-performance Nd-Fe-B magnets.

Kindly invited.