Course code	Course title
METRO 006	Materials Databases and Validation

Prerequisites

The course is addressed to advanced students and scientists from engineering and applied sciences interested in the fundamentals of the solidification problems. There are three lectures, first describing physics of the solid phase growth, second elucidating problematic of experimental validation of numerical predictions and the third describing fundamentals of modern databases. For understanding the lectures some basic course of physics is sufficient.

Training Objectives

The course should help students to understand principles of validating numerical models used for casting problems and to gain knowledge on constructing modern material databases.

Summary

Growth of solid phase. The lecture describes diffusion and convection, columnar and equiaxed dendrites, single dendrite growth (role of convection in the liquid phase), eutectic growth, formation of the alloy microstructure (dendrites interaction, mushy zone, interaction between mushy zone and liquid phase, chimney effects). The lecture is divided into five parts: first, a short introduction to the problem is presented and basic notions required to understand the subject are defined. Then, main factors which affect the crystal growth are described. In the next part growth of two morphological forms: dendritic and eutectics are discussed. Some aspects of interaction between grains are shown. Finally, some details of controlling single grain growth are given. The lecture is closed emphasising key-points and giving sources on which the lecture was prepared.

Verification and validation of numerical simulations. It describes basics of numerical verification and methods of validation. The lecture introduces necessity for performing verification and validation procedure before numerical code is applied to industrial problems. Advantage of constructing laboratory benchmarks based on *analogue* fluids is advocated for solidification problems.

Fundamentals of relational databases. Efficient and accurate management of databases collecting material properties plays and important role in any industrial solidification project. The course offers short introduction of the database management based on sequential queries processing system. Examples based on the Microsoft Visio program should allow to construct own database and to understand syntax of typical queries.