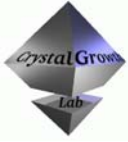


Modeling of Crystal Growth

Fraunhofer Institute of Integrated Systems and Device Technology (IISB)



Fraunhofer Institut Integrierte Systeme und Bauelementetechnologie



Fraunhofer IISB Crystal Growth

Software tools

Numerical modeling as an incomprehensive tool in modern process development is extensively used and promoted at the Department of Crystal Growth at Fraunhofer IISB. The in-house developed software packages of Fraunhofer IISB find application in all fields of crystal growth like bulk crystal growth of semiconductors (silicon, gallium arsenide, indium phosphide), fluorides, and oxides by Czochralski-like (Cz, LEC, VCZ), EFG and Bridgman/VGF methods. For global 3D simulations Fraunhofer IISB is additionally equipped with

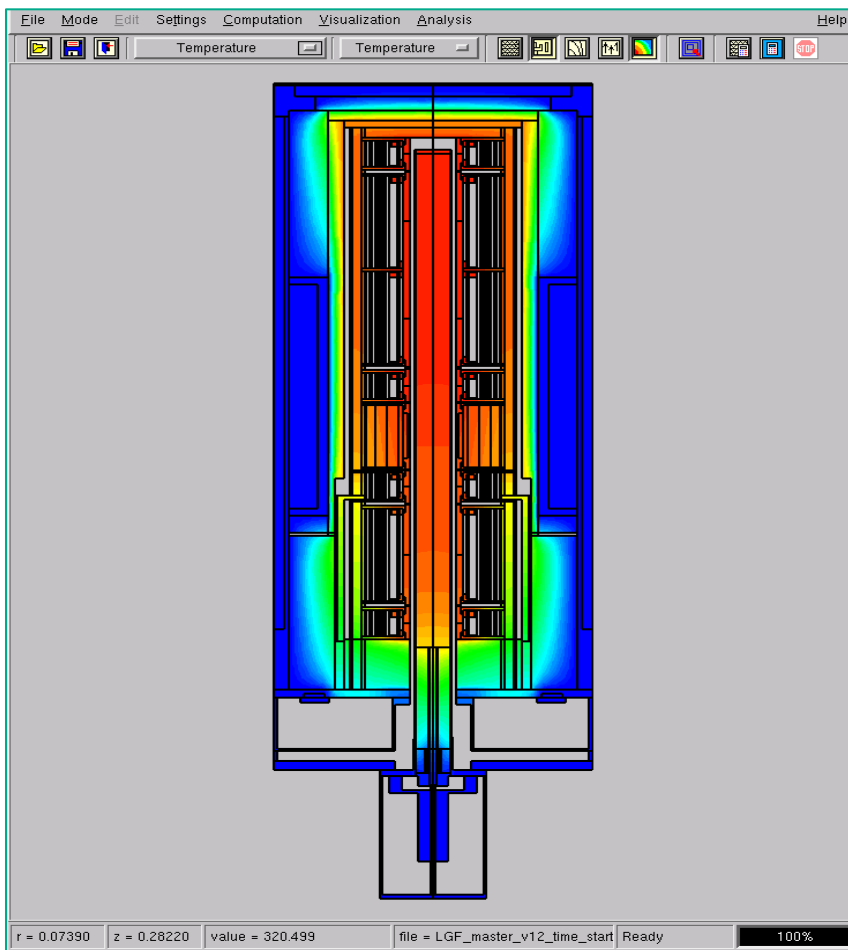
powerful commercial CFD software. Our in-house developed software tools CrysVUn, CrysMAS3D, and STHAMAS3D are tailored to solve global heat and mass transport phenomena in high temperature equipment with complex geometry. ORCAN* provides a flexible open source framework for scientific computing which helps the user to develop their own code or reuse other available numerical packages by providing a basic set of grid generators, solvers, and visualization.

*<http://sourceforge.net/projects/orcan>

Since several years our software packages are well established in industry and academia for optimizing thermal processes in the field of bulk crystal growth and alloy solidification and for predicting crystal defects and microstructures.

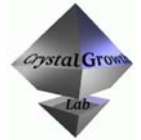
Our well documented tools are provided with easy-to-learn and easy-to-use graphical user interfaces.

Powerful numerical methods for solving inverse problems assist you efficiently when optimizing equipment and processes.



Global simulation with CrysVUn/CrysMAS





Models

Our software tools offer a variety of physical models:

- heat transport by (anisotropic) conduction
- heat transport by laminar and turbulent convection (gas and melt)
- heat transport by radiation between grey emitting surfaces and in absorbing media
- magnetohydrodynamic phenomena (steady and time-dependent fields)
- diffusive and convective mass transport
- phase transitions: crystal growth, eutectics, mushy zone
- resistance and inductive heating

Furthermore, special models are implemented for computation of

- moving furnace parts
- thermo-elastic stress and dislocations in crystals
- chemical reactions
- macrosegregation formation during alloy solidification

Applications

Our software tools are designed with your industrial needs in mind being robust, easy to use, fast, and accurate. The outstanding quality of our software tools and of our excellent service for our customers is evident from the fact that our software is used worldwide by industry and academia for definition of crystal growth and solidification equipment, for optimization of crystal growth and solidification processes, and for improving materials and reducing costs.

References

More than 100 installations of our software tools world-wide in industry and academia demonstrate the customer satisfaction. Several national and international scientific awards for the Department of Crystal Growth serve as signs for its world-wide leading position in the field of crystal growth and simulation.

Services

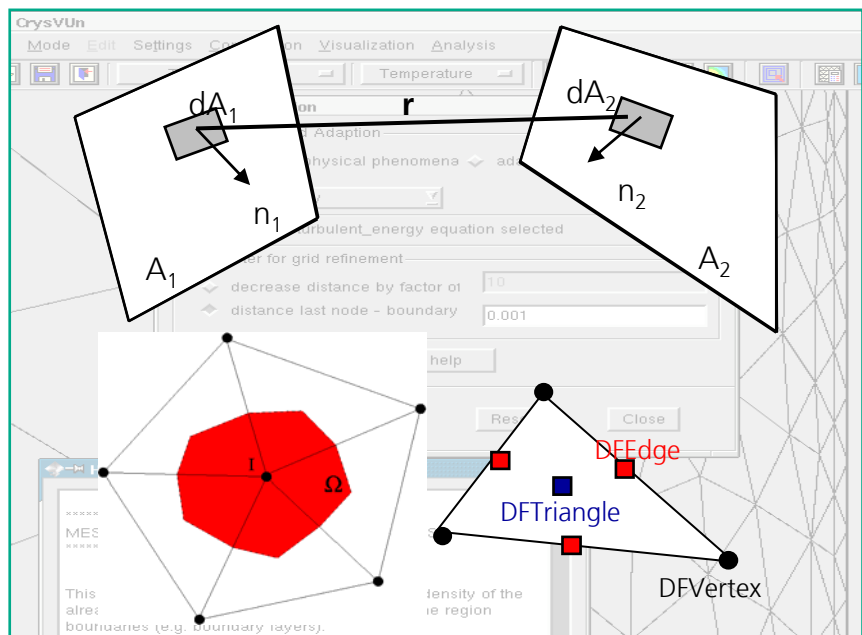
We put rigorous attention to product quality during the whole software development process, from requirement analysis, design, implementation, testing to version release, and code distribution.

We assist you by quick user support, on-line documentation, validation, consultancy and training.

We take care that you will become familiar with our tools during a 5 day training. The training gives you a general introduction to our software and teaches how to solve your specific problems.

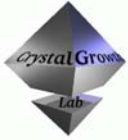
Our software runs successfully on PCs under Windows and SUSE Linux. Special versions are available for parallel computations in a homogeneous network.

Our team having close relation to the experimental problems is continuously improving our software tools according to your needs.



Advanced numerical mathematical and numerical methods are used within the software packages of Fraunhofer IISB





Fraunhofer IISB Crystal Growth

“Space station to Houston, we have no (!) problems”

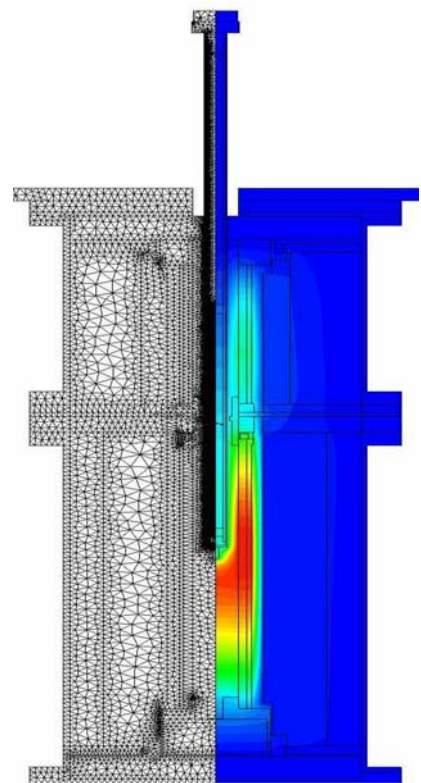
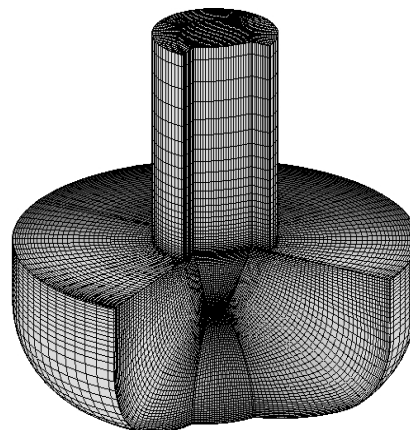
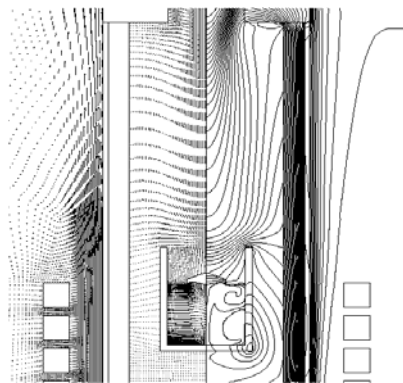
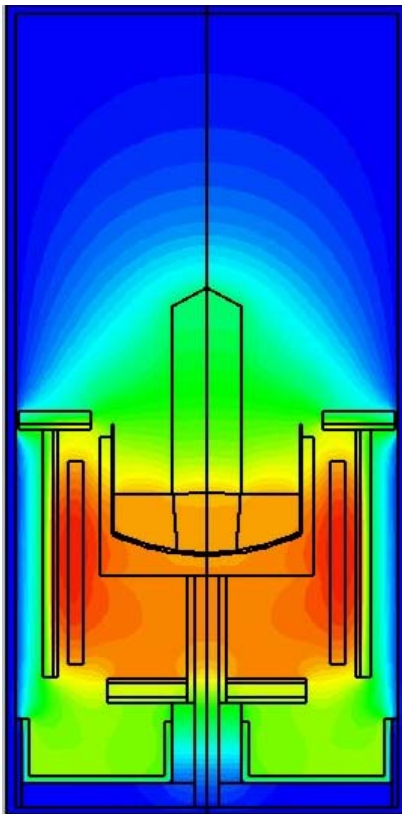
This could be the tune of future messages of astronauts from the ISS international space station to mission ground control whenever material science experiments are concerned.

The European Space Agency, ESA, is using a software package of Fraunhofer IISB to support

solidification experiments onboard the International Space Station (ISS) in the fields of metallurgy and semiconductor crystal growth.

In this process, several European research groups will be able to use the so-called Material Science Laboratory (MSL) of ESA for their

solidification experiments. The MSL will have different furnace modules available for processing samples. The IISB has developed computer models for these furnace modules. The planned experiments can then be better prepared using the “virtual MSL” of Fraunhofer IISB.



Typical examples where software of Fraunhofer IISB is used to solve heat and mass transport problems in crystal growth and related processes

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