

# Strong and Ultrastrong Magnetic Fields: and Their Applications (Topics in Applied Physics)

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Review

## Magnetic field controlled floating-zone single crystal growth of intermetallic compounds

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**Abstract.** Radio-frequency (RF) floating zone single crystal growth is an important technique for the preparation of single bulk crystals. The advantage of the floating-zone method is the crucible-free growth of single crystals of reactive materials with high melting points. The strong heat diffusion on the surface, as well as the melt convection in the molten zone due to induction heating, often leads to an undesired solid-liquid interface geometry with a concave (towards the solid phase) outer rim. These concave parts aggravate the single crystal growth over the full cross-section. A two-phase stirrer was developed at IFW Dresden in order to avoid the problems connected with these concave parts. It acts as a magnetic field pump and changes the typical double vortex structure to a single coil structure, thus pushing hot melt into the regions where the concave parts may arise. The current in the secondary coil is induced by the primary coil, and the capacitor and the resistance of the secondary circuit are adjusted to get a stable 90 degree phase-shift between the coil currents. Single crystal growth of industrial relevant NiAl and TiAl intermetallic compounds was performed based on the material parameters and using the adjusted two-phase stirrer. Very recently, the magnetic system was applied to the crystal growth of biocompatible TiNb alloys and antiferromagnetic Heusler MnSi compounds.

### 1 Introduction

Floating-zone single crystal growth is an important technique for the preparation of bulk single crystals. This is well-known from the industrial production of high-precision silicon, especially for power electronics. The advantage of this method is the crucible-free processing of highly reactive compounds where the melt zone is confined solely by the melt surface tension. Due to the large market for semiconductors, much effort has been devoted to understanding melt convection and the influence of external magnetic fields on the growth process of silicon single crystals and semiconductor compounds with well-known thermophysical properties. The research concentrated

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in.3Department of Physics and National High Magnetic Field Laboratory,. Florida State . Strong and Ultrastrong Magnetic Fields and Their Applications - Topics in.In addition, it will describe the application development of pulsed magnetic fields in tool for scientific research and industrial applications, such as solid state physics, A PLC (Programmable Logical Controller) system is applied to control the . valleys of bismuth can be totally emptied by ultra-strong magnetic fields [19 ].

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