New cold crucible technology for single crystal growth

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Abstract:

Single crystal growth from liquid phase like Czochralski or Kyropoulos processes needs a crucible. This crucible induces a strong interaction with liquid phase and creates contamination. This contamination has an important effect on the final applications. For example, in the industry of microelectronics, the crucible is made of fused silica, and a contamination in oxygen and carbon is found inside the wafer from the ingot. In oxide crystal growth like gallium oxide the crucible used is of iridium metal and a strong contamination is observed, moreover the iridium price is going from 50€ to 200€ per gramme during the last 4 years.

In parallel, the use of cold crucible technology is common in metallurgy or zirconia market. The cold crucible process is based on induction, with water cooled fingers. A Lorentz-Laplace force is induced inside the bulk, in order to create a strong fluid flow (good for homogenization) and a semi-levitation (good for contamination). Unfortunately, these conditions are not adapted to single crystal growth from cold crucible.

In the eighties, Wenkus & Menashi [2] and Ciszek [3] used a cold crucible in order to decrease the oxygen contamination level. They have shown that it was possible to get a small single crystal (2.5 cm in diameter), with a very low oxygen contamination. They concluded also that one of the major problems, as yet unresolved in the use of the cold crucible for the growth of single crystals, is related to the stabilization and precise control of the melt flow. In parallel, Osiko et. al. [4] have also demonstrate the possibilities to create small oxide single crystals from cold crucible, the diameter being also determined by fluid flow interaction with the crystal.

In this presentation, we will present the state of the art on the crystal growth in a cold crucible and we will present a new generation of cold crucible [5] in order to stabilize the fluid flow induced by the Lorentz force inside the melt.

References:

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