Combined crystal growth methods for extended chemical composition possibilities obtained from a high temperature solution

Philippe Veber[1]*, Gabriel Buse[2,3], Maria Poienar[2,3], Marius Stef[3], Akira Yoshikawa[4], Kei Kamada[4], Karol Bartosiewicz[5]
*lead presenter: philippe.veber2@univ-lyon1.fr
1 University of Lyon, CNRS, Institut Lumière Matière, F-69622, Villeurbanne, France
2 Institute for Advanced Environmental Research, West University of Timisoara, Oituz Str., No. 4, 300086 Timisoara, Romania
3 Faculty of Physics, West University of Timisoara, Romania
4 Institute of Materials Research, Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai, 980-8577, Japan
5 Faculty of Physics, Kazimierz Wielki University, Powstancow Wielkopolskich 2, str., 85090 Bydgoszcz, Poland

Several main families of crystal growth techniques operating from a high temperature liquid phase are available for growing different types of inorganic bulk crystals: oxides, halogenides, metals and semi-conductors [1-3]. These techniques include generally one solid-liquid single interface such as Czochralski, Bridgman and Top-Seeded Solution Growth (TSSG) conventional techniques. Besides, it has to be mentioned that two solid-liquid interfaces are present with the zone levelling and floating zone methods. In this context, two categories of materials are usually considered: congruent-melting and non-congruent-melting materials. For the first-category, materials are grown from a melt by conventional pulling techniques while for the second one, in which we include materials with extreme characteristics (*i.e.* very high melting point or very high volatilization rate of the liquid phase), the use of conventional pulling techniques is difficult or impossible to implement. In these conditions, the growth of the above-mentioned materials requires the use of a solvent, also called flux, in order to obtain a thermodynamically stable single crystal grown in a suitable moderate temperature range. Therefore, the TSSG is often employed. However, due to specific thermal features of this flux growth method, some solid solutions, for instance, cannot be grown with well-controlled compositions over a wide volume due to elemental segregation reflected by liquidus and solidus surfaces in thermodynamical phase diagrams. The combination of different conventional growth methods associated to flux method is presented as a way to achieve the growth of particular compounds and solid solutions: semi-conductors, fluorides and oxides. The control of thermokinetics parameters such as the pulling speed, growth atmosphere and thermal gradients are considered in order to reach an extended range of compositions [4-7].

References

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