# Prospects for single crystal growth at FTMC

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Crystal is a solid material in which constituent atoms exhibit a definite pattern of arrangement, and whose surface regularity reflects its internal symmetry. Two types of solid materials exist, namely amorphous and crystalline, with the former exhibiting randomly distributed atoms, and the latter consisting of highly ordered arrangements of atoms. Moreover, crystalline materials can be classified into two groups: single crystals and polycrystals, where the former is characterized by a continuous and unbroken lattice extending to the edges of the sample, while the latter comprises several crystallites distributed randomly and possessing numerous grain boundaries. As a result, single crystals demonstrate anisotropic properties that are crystallographic direction-dependent and are rarely observed in other types of materials, thereby rendering them suitable for practical applications.

However, the production of single crystal materials is a complex task. The principal methods of single crystal growth include solution, hydrothermal, vapor, and melt growth techniques. Of these, crystal growth from melts, where growth occurs at the interface of the liquid and solid, is of particular interest. The principal techniques employed in this approach include floating zone, where only a small portion of the sample is melted and recrystallized into a single crystal, Bridgman–Stockbarger method, in which a sealed crucible is moved from the hotter portion of an oven to a cooler one, Czochralski, where a growing crystal is pulled out of the melt, and flux growth, which is similar to Czochralski, except that the melt is not a pure material, but rather a flux solution.

$\beta$-$BaB_2O_4$ (BBO) is a material that exhibits nonlinear optical (NLO) and electro-optical properties, making it ideal for use in laser manufacturing. $BaB_2O_4$ displays two polymorph phases, namely alpha (high temperature) and beta (low temperature), with the latter exhibiting superior nonlinear properties. The $\beta \rightarrow \alpha$ phase transition temperature of BBO is 925°C, which is lower than its melting temperature of 1095°C, indicating that crystal growth from the flux solution is the preferred technique.

To obtain single crystal samples such as BBO at FTMC, appropriate equipment, specifically a suitable furnace, is necessary. Few manufacturers worldwide can supply this equipment, and thus, self-built furnaces are commonly used, as discovered during visits to crystal growth laboratories in European scientific institutions. As a result, we are presently preparing the design of a furnace and aim to have it built by the end of this year.